ESRI India

ESRI

A NIIT-GIS Publication

ArcIndia News

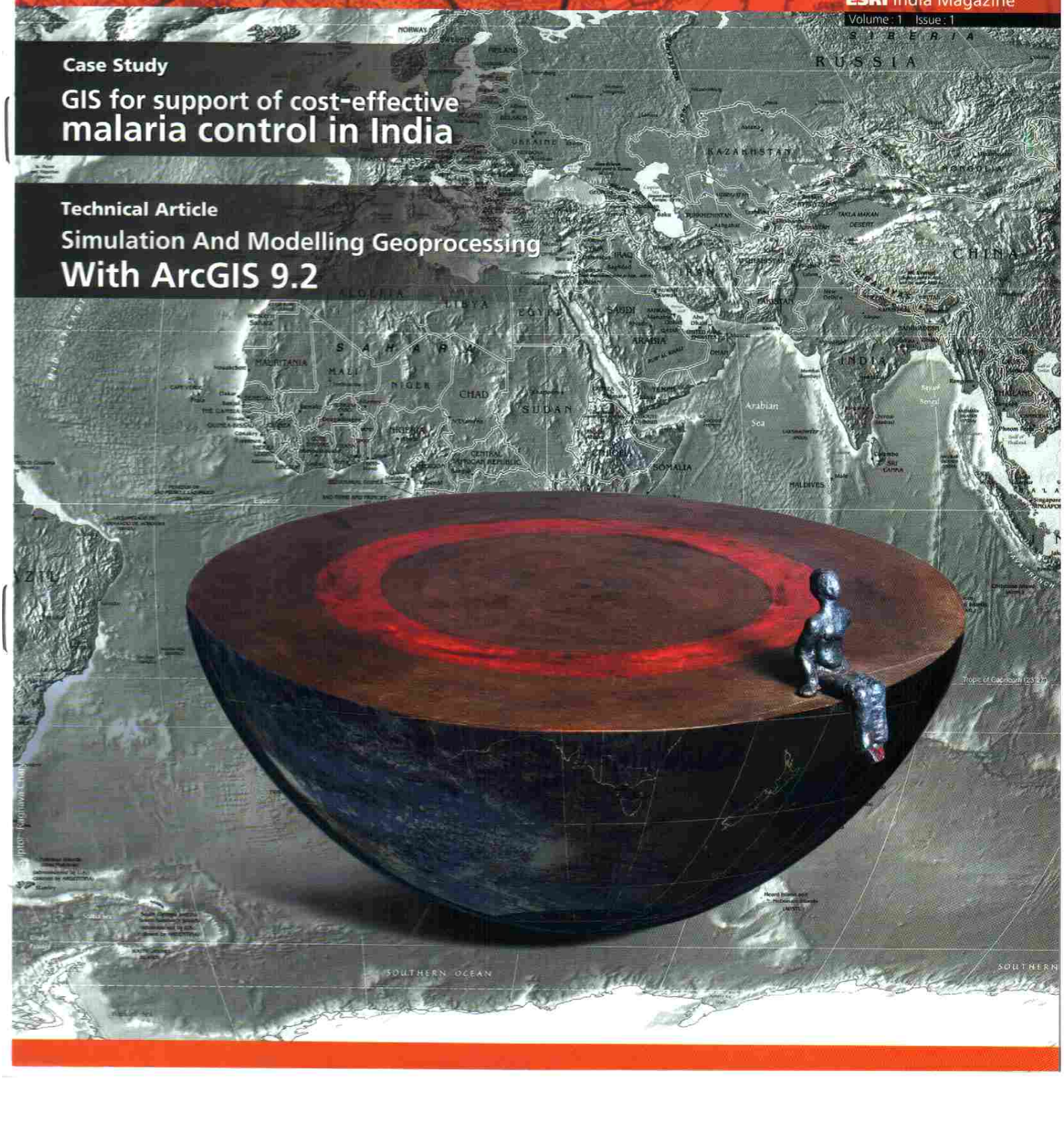
ESRI India Magazine
Volume : 1 Issue : 1

Case Study

GIS for support of cost-effective malaria control in India

Technical Article

Simulation And Modelling Geoprocessing With ArcGIS 9.2



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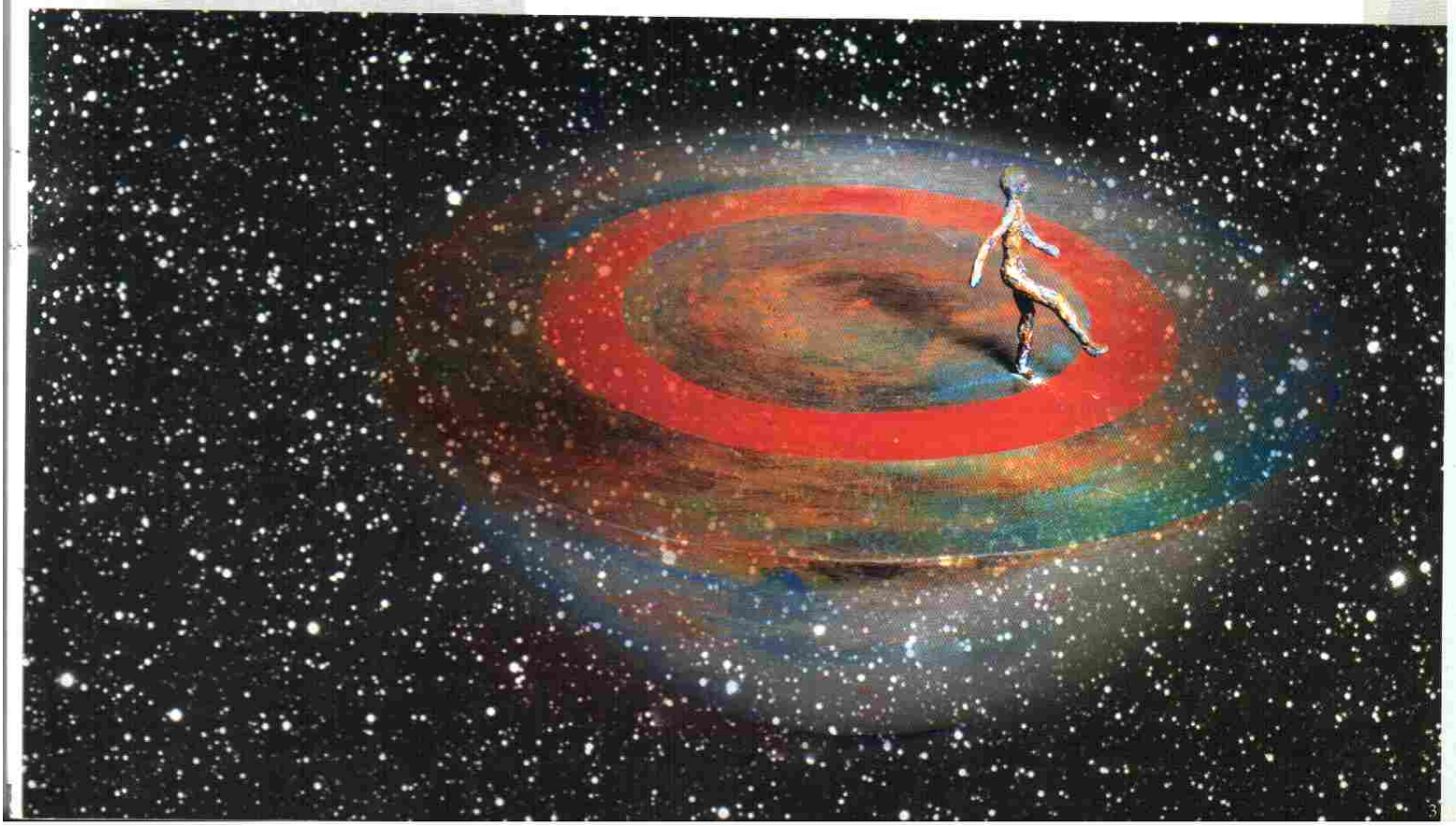


From The President's Desk

Rajesh C Mathur
President, ESRI India

Dear friends,

It is my pleasure to launch this very special initiative - *Arc India News* - a quarterly magazine dedicated to the country's GIS community, aiming to serve as a bridge between ESRI India, and you all, our valued customers.

The magazine which commemorates ten years of ESRI India and celebrates the company's achievements within the country's GIS market - will keep you updated on the trends and developments defining this rapidly expanding industry.

It was in November 1996 when Jack Dangermond, President, ESRI, Inc. and Vijay Thadani, President, NIIT Ltd., launched ESRI India, a GIS focussed software and services company. In these ten years, ESRI technology has been at the core of several national level GIS projects undertaken in our country, encompassing a cross section of domains including utilities, urban development, remote sensing, environment, infrastructure among others.

The company has also extended its reach to international geographies and today, ESRI India consultants are engaged in projects in USA, Europe and Asia Pacific region. The company has also achieved several awards and recognitions including GIS Solution Company of the Year award at Map India and High Achievement Award from ESRI, Inc.

I would like to thank you, our esteemed customer for your support without which we would not have achieved this success.

The world is going through very interesting times, where we are witnessing a paradigm shift in the way GIS is being implemented in organisations. From desktop systems to distributed geoprocessing; multi-tier architectures supporting enterprise systems, GIS is now becoming part of the IT system of large companies. There is of course a need for this technology to be more open and integratable. A need for standards and open architectures, which are extensible and scalable. And finally a need to create greater awareness about the crucial role GIS can play in the life of enterprises, helping them achieve higher productivity, efficiency and customer responsiveness.

ESRI, as the market leader, is driving these technological changes and is providing the necessary tools and building blocks to users to build enterprise systems, centered around GIS technologies.

ESRI India has also taken up the awareness generation cause with alacrity, and the magazine you hold in your hands is a key element of this exercise.

Besides keeping you abreast of the changes taking place within the global GIS landscape, Arc India News will also spotlight some of the significant work you have been undertaking within your own organisation using GIS systems and solutions. It will be our endeavour to feature some of these important deployments as Case Studies, which will serve as referral cases for other organisations across India, to follow.

Technology papers on GIS and inputs from academia, will also be part of the magazine.

At this time, I would also like to extend a warm invitation to each one of you, to the Second ESRI Asia Pacific User Conference, which is being hosted in New Delhi for the very first time by ESRI India. I would like to welcome delegates from India and users from the rest of the Asia Pacific region. I'd like to thank you all for the tremendous support you have extended to ESRI India and wish you all a very productive and enjoyable user conference.

Meanwhile, Arc India News, which will now become a part of our customer communication strategy, needs inputs from you. We will be glad to receive feedback on the magazine and suggestions on how it can be improved and tuned even further to fulfill your information needs.

I also invite you to contribute to the magazine by sending in articles, white papers and case studies that can be shared with the rest of the GIS world.

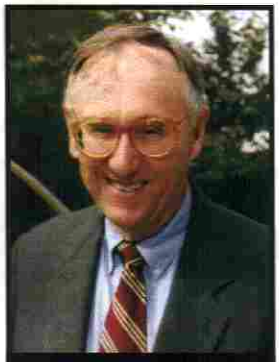
Thank you once again for contributing towards the success of ESRI in India. I look forward to interacting with you at the conference.

Warm regards,

Rajesh

Rajesh C Mathur

President, ESRI India



Jack Dangermond
President, ESRI

Friends,

I am delighted that ESRI India is launching *Arc India News* magazine for interfacing with India's GIS community. Clearly, the country is not just a fast-growing consumer market for GIS technologies, it is also emerging as a global hub for outsourcing GIS services.

As someone who has been involved in the GIS industry for many moons, I have been part of its evolution and growth. From a situation where GIS systems were the prerogative of certain specialised verticals, today, these solutions have pervaded almost all key industries and are being harnessed by large organisations to deal better with the information residing within their domains. The government sector, in particular, has been putting GIS technologies to good use, and increasingly, these solutions are helping policy makers combat natural and other disasters. Whether it is determining the damage caused by the tsunami in Asia, or analysing the impact of an earthquake in Peru GIS is proving to be the technology that works in times of crises.

At this time, I would like to congratulate ESRI India for the work that it has been doing in the Indian market for the last ten years. The company has made significant strides on Indian soil and its current efforts, to move beyond the boundaries of the country to cater to customers across Asia Pacific and elsewhere, are also laudable. We have been watching with interest the developments taking place in the Indian GIS market and the role ESRI India has been playing in nurturing, growing and leading the industry here. I would like to add that we are proud to partner with ESRI India, and its parent company, NIIT Technologies, in providing state-of-the-art GIS solutions to the country's customers.

I'd like to once again congratulate ESRI India for introducing this magazine, which will create a platform for India's GIS users to gettogether, interact and learn about the trends and technologies driving the global industry. I am sure the initiative will be a great success and add value to ESRI India's offerings for its customers.

Cordially

Jack Dangermond

President, ESRI

Impact Of GIS On National Development

Rajendra S. Pawar
Chairman, NIIT

Geographic Information Systems (GIS) have gained in relevance and usage in India in the last decade. The proliferation and spread of GIS in the country has taken on the flavour of a quiet revolution, with the movement gradually gaining momentum within leading corporates and user organisations across the nation.

The growing popularity of GIS rests in large part on the increasing awareness about these solutions and the beneficial impact they can have on business, the expanding base of professionals trained on these platforms and the ready availability of cost-effective GIS software that can even be deployed on desktops!

A spate of global conferences on GIS, hosted by Indian organisations over the last few years, have revealed a significant community of user companies, that are innovatively harnessing the power of GIS to collate information, locate available information spatially, view it from a comprehensive shared database and customise GIS data for various purposes.

Increasingly, Indian companies and government departments are using GIS solutions in areas such as natural resources management, land information systems, urban planning and other applications segments.

Realising that GIS solutions enable them to work with available data more effectively and make the output of research more comprehensible, policy makers are actively deploying these systems within the workplace. The rising demand for statistical information systems have made GIS solutions even more indispensable to decision makers in recent times. These systems have virtually transformed the manner in which geographic areas are being defined and socio-economic data produced and analysed.

GIS solutions and tools, for instance, played a key role in determining the extent of damage wrought by the tsunami on India's coastal population. Countless such instances exist, where GIS has played an important role in improving commerce and transforming day-to-day lives. From understanding metropolitan settlement and activity patterns, analysing the relationship between rural and urban areas, providing outputs as a visual representation in a geog -raphic context, to creating maps as both search interfaces and output options, GIS has become all pervasive.

India has relevant infrastructure for fuelling GIS growth

GIS solutions as a domestic and export market opportunity, also have high potential in the Indian context. According to industry analysts, GIS services exports from the country are growing at a healthy 30-40 percent annually. Domestic market expansion is also estimated to be of similar order. Within the country, in fact, the opportunity is substantial. India has relevant infrastructure for fuelling GIS growth. A large number of organisations, including the Geological Survey of India, the National Informatics Centre, the Wildlife Institute of India, Space Application Centre, DDA, the National Remote Sensing Agency, among others are collating geographic information on numerous subjects. These organisations also rank among the large users of GIS software and services.

Clearly, India's GIS industry is on a growth path and expected to increase its share in the global markets. India's key GIS players such as ESRI India, have not only built their credentials within the country, they have also found favour with a growing number of prestigious global customers.

GIS and national development will move hand-in-hand in the years ahead each one spurring the growth of the other.

Evolution Of GIS With NIIT

Arvind Thakur CEO, NIIT Technologies

NIIT Technologies is one of the earliest entrants into the Geographic Information Systems (GIS) space in India. The company's GIS journey began as far back as 1996, when the country's GIS sector was still a fledgling, finding its feet. In those days, awareness about GIS was extremely low and even those organisations that had some exposure to this new technology, did not know how to best use it or benefit from it.

NIIT took the pioneering step of partnering with the world's number One GIS company, ESRI Inc., to make available the leader's offerings on Indian soil. ESRI India was a strategic alliance between NIIT Technologies and the global major to offer a spectrum of GIS and image processing products and services.

ESRI brought to India, the globally, popular ArcGIS product suite, encompassing solutions for geographic data creation, management, integration, analysis, and dissemination for every organisation, from an individual to a globally distributed network of people. ESRI India became the one-stop-shop, end-to-end solutions provider for GIS software, training, technical support, data conversion, application development, digital photogrammetry and consulting.

Over the last decade, ESRI India has achieved leadership status in the GIS market in India, Bhutan and Nepal, having built up the largest installed base of customers across various verticals. ESRI customers are the some of the most reputed names in the Government, corporate and education segments and include the Department of Space, the National Informatics Centre, State Forest Departments, Survey of India, Ministry of Environment & Forests, Geological Survey of India, Reliance Infocomm and educational institutions like the IITs, IIMs, numerous universities and their affiliated colleges. ESRI India has not only managed to bag key GIS projects, it has also spurred the usage of these solutions and services in various mission critical national-level applications, encompassing areas such as environment, forestry, land records, and utilities. With ESRI India emerging as the largest distributor of GIS software in India and gaining recognition as a leading Business Partner for ESRI Inc., NIIT Technology decided to leverage this expertise and take it to the international markets.

ESRI India remains on the growth path

It was in 2004, at the NASSCOM Global Leadership Forum in Mumbai, that NIIT Technologies, announced its intent to take GIS solutions and services to users in Europe, USA, Africa, Middle East and South East Asia.

In this way, ESRI India became the spearhead for NIIT Technologies' global GIS ambitions, and enabled NIIT to take its GIS skill sets, built in India, to some of the major, high opportunity markets beyond the country's borders.

In order to address this market, NIIT Technologies set up a dedicated development facility for GIS services in Parwanoo, Himachal Pradesh.

The tremendous growth being witnessed by the Geomatics industry, both within India and overseas, will ensure that ESRI India remains on the growth path.

The company goal today is to not only sustain and strengthen its leadership in the domestic market, but also establish India as the preferred choice for sourcing GIS services by global users of spatial data.

ESRI India expands its facilities in Delhi and Parwanoo:

To augment the growing present and future needs of its national and international customer's, ESRI India has further added two facilities to its current infrastructure. The first phase of expansion was done in Parwanoo (HP) to augment the existing setup. The Parwanoo setup of ESRI India, located in the lush green low rolling Shiwalik hills, caters to the data conversion requirements of the customers. In the second phase, another facility was added in Delhi to primarily enhance the application development center.

Campus Connections:

For ESRI India, campus hiring is an essential element of the companies recruitment strategy to create a diverse pool of GIS talent. Last year the company visited various esteemed GIS/remote sensing institutes like IRS, IIRS, Symbiosis Institute of Geoinformatics, JNTU, IIT Roorkee, IIT Bombay et. al. to hire the best breed of talent. These young minds were put through a five-week extensive induction and training programme. The programme embraced modules like company orientation, product overview, advanced product training, sales training, project management, role plays & demo.

What's new:

1. Recently, ESRI India has successfully conducted its ninth batch of GIS Training "GIS : A Decision Tool for Forestry Planning & Management" for senior Indian Forestry Officers (IFS) sponsored by Ministry of Environment & Forests (MoEF).

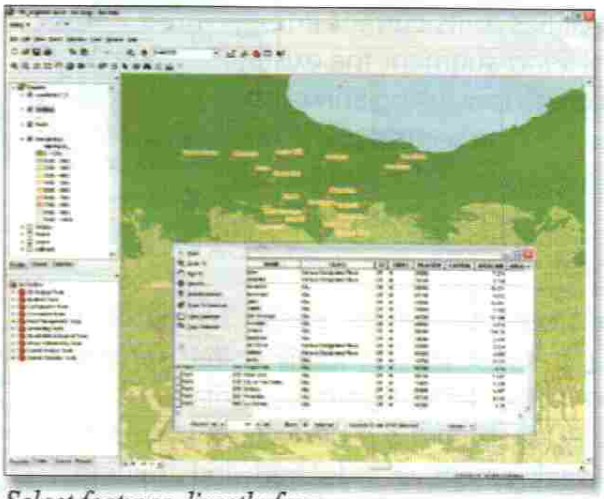
   More than 200 officers have already been trained with high feedback ratings among all institutes conducting trainings for MoEF.

2. After successful completion of training modules and workshop for senior officers of Integrated Defence Services and Indian Air Force, at present ESRI India is engaged in imparting 27 instructor days customised module "Diploma in Geo-informatics" for senior officers of Indian Defence Services at Pune.

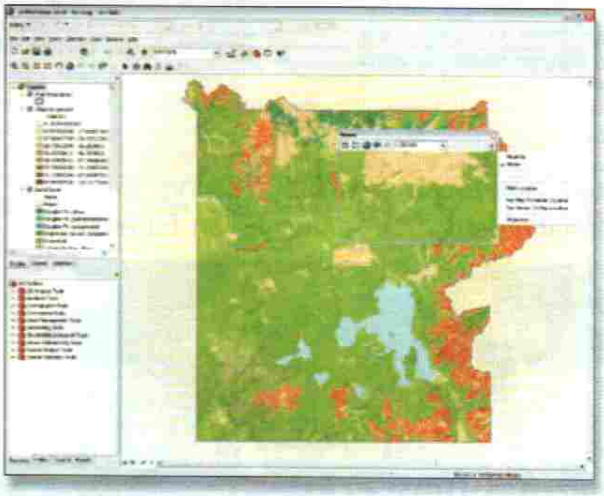
3. Check out the online technical support service on www.esriindia.com/support/support.htm for prompt technical assistance on any of your technical query.

4. Check out the latest training announcements and online registration www.esriindia.com/training/index.htm for the new trainings launched by ESRI India.

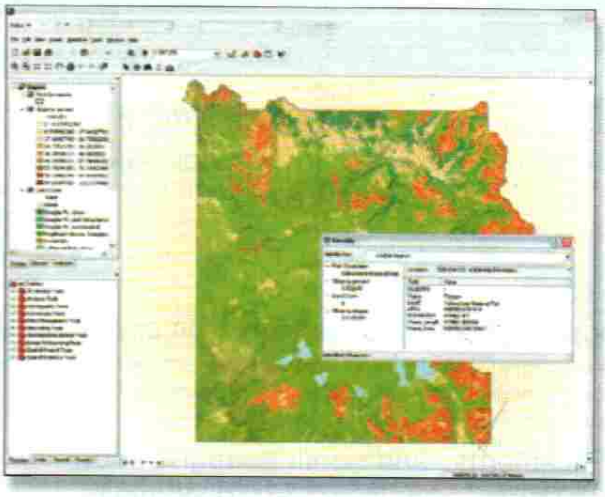
Take Advantage Of The Productivity Features In ArcGIS 9.2



Select features directly from rows in the table window.



View data at multiple scales at the same time with the new Viewer window.



The enhanced Identify tool can drag a box & sort & hide fields.

Many new features and enhancements in ArcGIS 9.2 focus on improving productivity. In this release, tables are easier to work with and maps now have better navigation, improved map display, and shortcuts that let users investigate map data more efficiently. Specific shortcuts have been added for frequently used ArcMap tools such as the Edit and Sketch tools. The accompanying quick reference sheet lists some of the most useful time-saving tips and shortcuts for ArcGIS 9.2, grouped by tool or software component. It was designed to be torn out.

New Ways for Working with Tables

Now Excel spreadsheets are automatically listed in ArcCatalog. Named ranges in an Excel spreadsheet can be accessed as a table. New tools and navigation enhancements make it much simpler to work with all tables in ArcGIS 9.2.

- Use the new Calculate Geometry dialog box to easily calculate area, perimeter, length, x and y locations, and centroids.
- Turn fields on and off, specify field aliases, and change the number format directly from the table window.
- Use new appearance properties to add long field names and values that wrap in the table window.
- Print tables directly from the table window.
- Navigate directly to features on the map by interacting with rows in the table window.
- Take advantage of many new shortcuts for working with and editing data in tables.
- Easily remove records from tables when selected records are displayed.

Better Map Navigation

The new navigation enhancements for ArcMap use the mouse wheel for zooming, panning, and recentering a map, eliminating the need to switch tools while working. Get a list of navigation tips and shortcuts from within ArcMap by clicking inside the table of contents and pressing F1. Other map navigation improvements include

- Customise the map extent acquired by the Full Extent button.
- Specify scale with the new customisable scale control that includes support for relative scale input.
- Work with data at multiple scales simultaneously with the new Viewer window.
- Use the new tab on the enhanced Find dialog box that finds places using a free online world gazetteer service.
- Use the new My Places dialog box to quickly access frequently used addresses, locations, and extents from any map or globe.
- Use the new Flicker command for change detection and data comparison, added after prerelease.
- Take advantage of new Group layers functionality: dedicated transparency, contrast, and brightness properties. Group layers also now support the Swipe tool.
- Drag a box and sort and hide fields using the enhanced Identify tool.
- Add field aliases in place of field names when using the Select By Attributes and other key dialog boxes.

Map Document Improvements

Enhanced Measure tool adds functionality such as area and feature measurement and running total. The Set Data Source(s) command in ArcCatalog now supports updating references in map documents to ArcSDE geodatabases, coverages, tables, rasters, and all geodatabase data types. File geodatabases are also supported. Make relative paths the default setting for all new map documents using the new Map Properties.

A Selection of Time-Saving Shortcuts

Map Navigation		
Function	Shortcut	Availability
Refresh and redraw the display.	F5	9.1, 9.2
Suspend the map's drawing.	F9	9.1, 9.2
Zoom in and out.	Roll the mouse wheel backward and forward. Hold down Ctrl for a finer zoom. To switch direction of the mouse roll, go to Tools >Options >General tab.	9.2
Center map.	Click mouse wheel. Ctrl + click to center and zoom in.	9.2
Pan.	Hold down mouse wheel and drag	9.2
Zoom in on box you define.	Ctrl + drag mouse wheel	9.2
Temporarily change to Zoom In tool.	Hold down Z	9.2
Temporarily change to Zoom Out tool.	Hold down X	9.2
Temporarily change to Pan tool.	Hold down C	9.2
Temporarily change to Continuous Zoom/Pan tool.	Hold down B	9.2
In layout view, apply the navigation to the data frame rather than the page.	Shift + navigation shortcuts	9.2
Nudge or scroll map.	Arrow keys or Home, End, Page Up, Page Down	9.2
Go back to the previous extent.	<	9.2
Go forward to the next extent.	>	9.2
Open context menu of useful shortcuts to various commands.	Right-click map in data view with any tool	9.2
Toggle among Zoom In tool, Zoom Out tool, or Pan tool when one is active.	F6	9.2
Full Extent	Insert	9.2
Zoom to layer's extent.	Alt + click layer name in the table of contents	9.2

Table of Contents		
Put keyboard focus on the table of contents.	F3 (or click the table of contents)	9.1, 9.2
Put keyboard focus on the map.	Esc (or click the map)	9.1, 9.2
Expand/Contract selected items.	Left/Right arrows (or + and - keys)	9.1, 9.2
Expand/Contract all the items at that level.	Ctrl + click an expansion control	9.1, 9.2
Turn on/off selected layers.	Spacebar	9.1, 9.2
Turn on/off all layers.	Ctrl + spacebar	9.1, 9.2
Turn on/off all layers at that hierarchical level or all selected layers.	Ctrl + click a check box	9.1, 9.2
Activate data frame.	F11 (or Alt + click a data frame)	9.1, 9.2
Cycle through each data frame and activate it.	Ctrl + Tab	9.1, 9.2
Open context menu for selected item.	Application key (or Shift + F10)	9.1, 9.2
Rename selected item.	F2	9.1, 9.2
Open properties dialog box of a selected item.	F12 (or Enter)	9.1, 9.2
Select multiple layers in the table of contents.	Ctrl + click (or Shift + click)	9.1, 9.2
Copy layers inside a data frame instead of reordering them, or move layers between data frames instead of copying.	Hold down Ctrl and drag and drop	9.1, 9.2

Tables		
Open context menu of field management shortcuts.	Right-click field name	9.1, 9.2
Open context menu of selection and navigation shortcuts.	Right-click gray cell to the left of a record	9.2
Open table for any item in the table of contents.	Ctrl + double-click	9.2
Open tables for selected items in the table of contents.	Ctrl + T	9.2
Close all open table windows.	Ctrl + Shift + F4	9.2
Sort field.	Double-click field name	9.2
Turn off field.	Ctrl + double-click field name	9.2
Zoom in and out on table window.	Ctrl + roll mouse wheel	9.2
Toggle Show All and Show Selected views.	Ctrl + Tab	9.2
Select all records.	Ctrl + A (or Shift + click top left gray cell)	9.2
Deselect all records.	Ctrl + Backspace (or click top left gray cell)	9.2
Switch selection.	Ctrl + U (or Ctrl + click top left gray cell)	9.2
Deselect row.	Backspace	9.2
Work sequentially through table, selecting each record in turn.	Ctrl + Enter	9.2
Go to cell below.	Enter	9.2
Go to cell to right and wrap around to next row down.	Tab	9.2

Tables (Continued)		
Function	Shortcut	Availability
Go to first cell in the current column.	Ctrl + Up arrow	9.2
Go to last cell in the current column.	Ctrl + Down arrow	9.2
Zoom to selected features.	Ctrl + Shift + =	9.2
Flash the current feature.	Ctrl + 8	9.2
Zoom to the current feature.	Ctrl + =	9.2
Pan to the current feature.	Ctrl + P	9.2
Identify the current feature.	Ctrl + I	9.2
Zoom to feature represented by a record and select it.	Hold down Ctrl + double-click to select and pan	9.2
Start or stop an edit session.	Ctrl + Shift + E	9.2
Copy cell value onto the clipboard.	Ctrl + C	9.2
Copy selected records onto the clipboard.	Ctrl + Shift + C	9.2
Start editing a cell.	F2	9.2
Cancel editing and restore cell's original value.	Esc	9.2
Delete the selected records.	Delete (or Ctrl + D)	9.2

All Editing Tools		
Show vertices of features near your cursor.	V	9.1, 9.2
Temporarily suspend snapping (especially useful when tracing along features).	Spacebar	9.1, 9.2

Sketch Tool		
Create a segment parallel to an existing one.	Ctrl + P	9.1, 9.2
Create a segment perpendicular to an existing one.	Ctrl + E	9.1, 9.2
Create a segment at an exact angle.	Ctrl + A	9.1, 9.2
Create a segment at an exact length.	Ctrl + L	9.1, 9.2
Create a segment at an exact angle and length.	Ctrl + G	9.1, 9.2
Enter coordinate by value.	F6	9.1, 9.2
View the snapping tolerance represented as a circle around your cursor.	T	9.1, 9.2
Delete the sketch.	Ctrl + Delete	9.1, 9.2
Finish the sketch.	F2	9.1, 9.2
Finish a part of the sketch to create a multipart feature.	Shift + double-click	9.1, 9.2
Undo last edit.	Ctrl + Z	9.1, 9.2

Edit Tool		
Move the selection anchor.	Ctrl	9.1, 9.2
Toggle through selected features within the selection tolerance to select correct one when there are multiple overlapping features.	N	9.1, 9.2
Toggle among Edit, Sketch, and Edit Annotation tools when one is active.	E	9.1, 9.2

Editing Tips and Time-Savers	
When editing in ArcMap, you can do on-the-fly unit conversion if you specify the unit type when you type a distance. When you enter a distance into a pop-up window, press F1 to get a list of the unit abbreviations you can use.	9.1, 9.2
Use the sticky move tolerance on the Editing Options dialog box to set a minimum number of pixels your pointer must move on the screen before a selected feature is moved. This helps prevent features from being accidentally moved small distances when they are clicked with the Edit tool.	9.1, 9.2
Customize the Editor toolbar to move the Start Editing, Stop Editing, and Save Edits commands onto the toolbar itself. Once moved, right-click each control and choose Image Only to show it as a button you can access with just one click.	9.1, 9.2
In any application, click Tools > Customize to enter customization mode where you can drag controls around to rearrange the user interface the way you want.	9.1, 9.2
Access context-sensitive help by clicking the What's This tool and clicking any command or button. To get context-sensitive help for a command on a context menu, highlight the command and press Shift + F1.	9.1, 9.2
In ArcCatalog, drag a folder onto the entry at the top of the Catalog tree to create a folder connection to it.	9.1, 9.2
Rename your folder connections in ArcCatalog to give them more meaningful names.	9.2
Use the Window > Viewer command or the Create Viewer Window tool on the Data Frame Tools toolbar to set up custom viewer windows. Viewer windows are fully functioning live ArcMap displays, so all tools and navigation shortcuts work inside them.	9.2
In the Catalog tree, drag and drop your most frequently used coordinate systems into the top level of the Coordinate Systems folder for quick access to them on dialog boxes.	9.2
Control how far out the Full Extent button will take you by setting the full extent property on the Data Frame Properties dialog box.	9.2
In a table, calculate area, length, perimeter, centroid, and point coordinates by right-clicking the name of a text or numeric field and choosing Calculate Geometry.	9.2
The Results tab on the ArcToolbox window keeps a record of all the geoprocessing you have done.	9.2
Right-click any tool in the ArcToolbox window and click Batch to execute a single tool multiple times with different inputs without your intervention.	9.2

Additional ArcGIS Resources

What's New in ArcGIS: www.esri.com/whatsnew
ArcGIS Desktop Help Online: www.esri.com/webhelp
Support: www.esri.com/support
Training: www.esri.com/training
Books: www.esri.com/esripress

GIS For Support Of Cost-effective Malaria Control In India

Aruna Srivastava, B.N. Nagpal, Rekha Saxena and A.P. Dash

In India, currently about 2 million malaria cases are being reported annually. Out of these 40% constitute P. falciparum (National Malaria Eradication Programme, annual reports). Today the disease has occupied various ecological niches and its control requires a thorough understanding of spatial and temporal changes in vector abundance and disease. RS and GIS empowers one to see the landscape in an entirely new dimension. RS can help in quick data management and GIS can provide valuable information regarding vector and disease distribution, interaction of risk factors, morbidity/mortality patterns and health resources allocation.

Worldwide RS and GIS is being used for decision support in disease control (Wood et al. 1992, Kitron et al. 1992, Beck et al. 1994, Sharma et al. 1996, Sharma & Srivastava 1997, Srivastava et al. 1998,1999, 2001.) The present study was an attempt to map the positive corridors of An. minimus, a malaria vector of north eastern India, identify malaria risk free areas for decision support for cost effective malaria control by limiting control activities in problem areas.

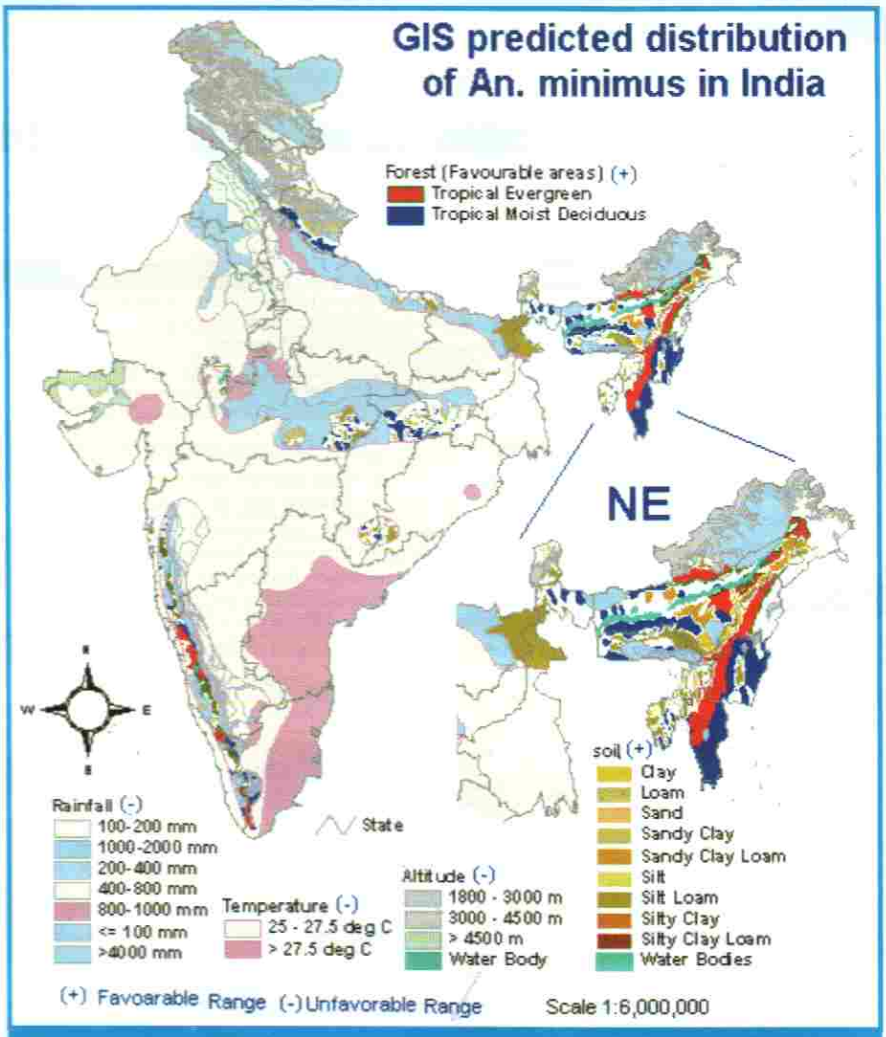


Fig.1 : GIS predicted favourable areas for An. minimus in India, Favourable areas shown in Red and Blue colour depicting two kinds of forest cover i)Evergreen ii) Moist Deciduous. Inset shows details of distribution of An. minimus in malaria endemic states of India.

Material and method:

An. minimus is essentially found in hill and foothill areas of tropical monsoon regions. The species is the most important vector of malaria along the foothills of Himalayas from Uttaranchal (earlier Uttar Pradesh) in north to northeast in India. It breeds in streams, ditches, channels, tea garden drains etc. but prefers to breed in clear, unpolluted slow moving water with grassy and partially shaded edges (Nagpal and Sharma 1987).

Forest cover, soil type, altitude, rainfall and temperature were considered for mapping of distribution of An. minimus

Because of its occurrence in forested areas in foothills, ecological parameters such as forest cover, soil type, altitude, rainfall and temperature were considered for mapping of distribution of the species. Reported distribution formed the baseline information. Each reported location was identified on thematic maps to decipher the corresponding parametric values. A matrix was formed to identify the favourable range for each parameter for the species. Digitisation, overlaying and analysis was done using Environmental Science Research Institute (ESRI), U.S.A. GIS software Arc/ Info NT 8.1 and Arc View 3.2. A three dimensional space was considered, location of each value of each parameter on ground was defined by X_{IJ} and Y_{IJ}, attribute information was taken a the third value i.e. Z_{IJ}.

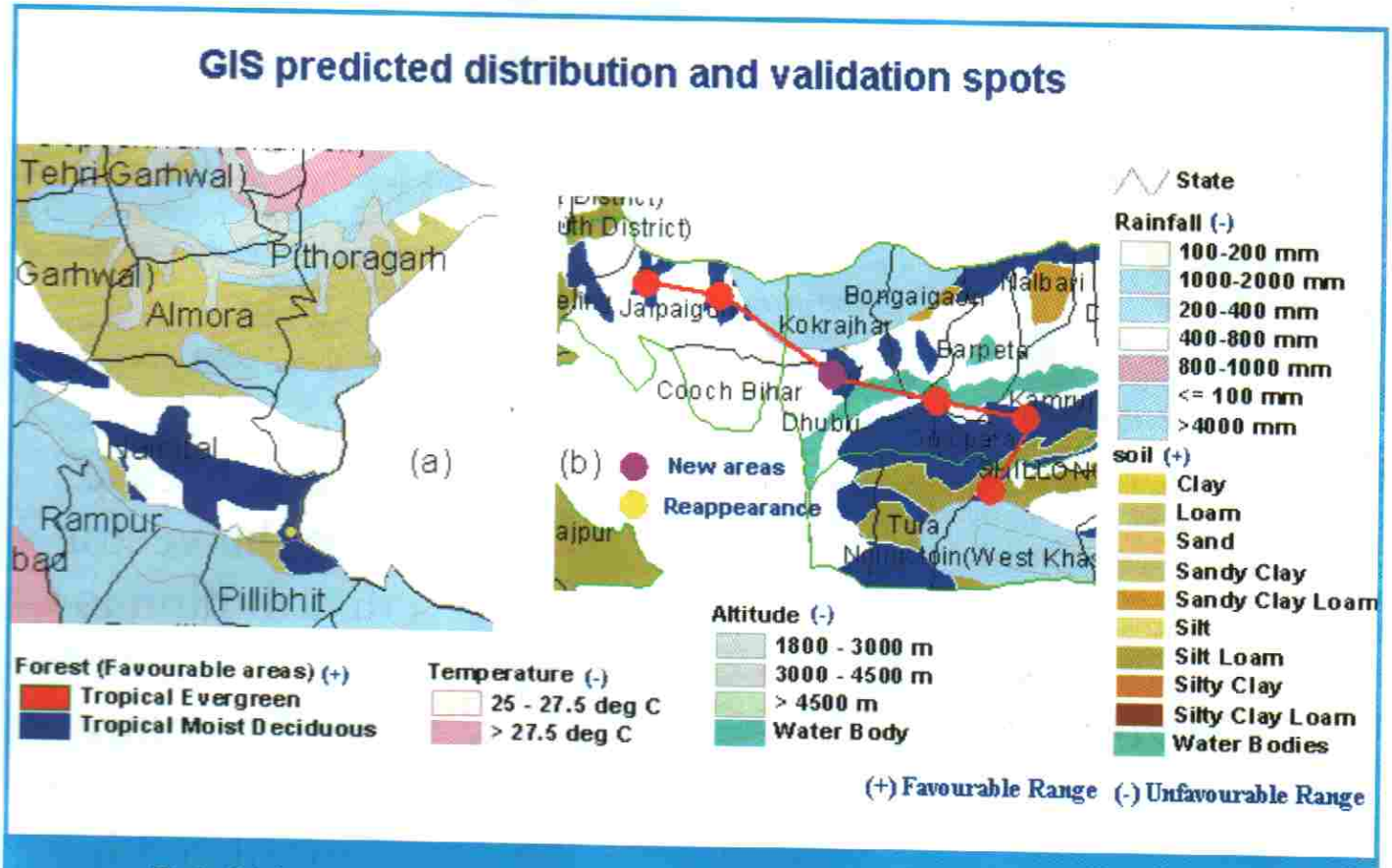


Fig.2 : Validation spots in GIS predicted distribution areas of An. minimus. At all favourable locations species could be collected. Pink dot shows areas where the species has been reported for the first time, yellow dot shows area of reappearance of the An. Minimus.

Favourable areas were extracted out and were combined using the Boolean operators Intersection (∩) and Union (∪) using the following expression.

$$\bigcap_{j=1,2,\ldots 5} \{ (X_{lj}, Y_{lj}, Z_{lj}) < \bigcup_{j} (X_{kj}, Y_{kj}, Z_{kj}) < (X_{hj}, Y_{hj}, Z_{hj}) \} \quad \ldots\ldots (2)$$

Where (X_{kj}, Y_{kj}, Z_{kj}), j=1,2,3,4 and 5 denote all geographic locations having favourable values of the habitat variables forest, altitude, rainfall, temperature and soil respectively.

Results and discussions:

Integration of favourable areas in thematic maps namely soil, forest cover, rainfall, temperature and altitude using GIS exhibited areas favourable for An minimus (Fig. 1).

Surveys were conducted to validate the results in favourable and non-favourable (northeast) areas by our team as well as an independent team, sites were selected both from reported and non_reported areas. Surveys were conducted in four states namely, Uttaranchal in the north, West Bengal, Assam and Meghalaya in northeast. In the northeast a stretch of 900 kms was covered, areas are shown in figure 2 a And b. Amazingly, An. minimus was collected from all locations in GIS predicted favourable zone. In two districts, namely, Champavat, Banbasa area of Uttaranchal and Dhubri of Assam; in the former, the species was reported to have disappeared after 1950s (Chakraborty and Singh 1957), and in later, it was not reported in earlier entomological surveys, during present surveys in both the places An. minimus was encountered (Malaria Research Centre annual reports). Thus besides validation of GIS prediction, re-appearence of An. minimus at Banbasa and first report from Dhubri was established. GIS predicted precisely the location in these districts to conduct entomological surveys and the species could be found there. Blind survey was conducted by independent team in both favourable (Kamrup) and non-favourable areas (Karbi Anglong). In favourable areas the species was found and in non-favourable area on the border of Karbi Anglong species was found to be absent.

Surveys were conducted in four states namely, Uttaranchal in the north, West Bengal, Assam and Meghalaya in the northeast

Using GIS, per cent favourable area for distribution of An. minimus in different states was estimated and thus the problem free areas were also identified. It shows that most of the area in north-eastern states is favourable for An. minimus. In Mizoram favourable area is about 90.61%, Manipur about 70%, Nagaland, Tripura and Assam about 35, 33 and 25 per cent respectively.

In other states it is less then 10% except Kerala. There are some favourable areas in Kerala and Maharashtra, till date there is no report of An. minimus from these areas. The authors intend to emphasise that this unique technique identifies the location for precision surveys in an area where the species is likely to be found,

In Mizoram, favourable area is about 90.61%, Manipur about 70%, Nagaland, Tripura and Assam about 35, 33 and 25 percent respectively

and also location wise control activity may be limited in favourable areas which may be effective in terms of results and cost.

The technique is fast and can be easily duplicated at desired scale in other parts of the country / world. In any disease, once the vector distribution is known, species specific control measures can be formulated in cost-effective manner and also disease control activities can be limited to problem areas.

Acknowledgment:

The authors acknowledge the Indian Council of Medical Research for financial support under Task Force Project.

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In any disease, once the vector distribution is known, species specific control measures can be formulated in cost-effective manner and disease control activities can be limited to problem areas

'Feature-rich ArcInfo Built NRIS'

National (Natural) Resources Information System (NRIS) was perhaps the largest GIS-based project taken up by the Government of India. What's the objective behind the programme?

NRIS was conceived as a part of the National Natural Resources Management System (NNRMS) as far back as 1983 and presented during the NNRMS Symposium at Hyderabad. Prof Dhawan, the then Secretary, DoS and Prof MGK Menon, the then Chairman, Planning Commission, had come to the conclusion that it was necessary to use modern technologies like remote sensing and GIS to promote scientific decision-making in the field of natural resources management. As India was about to launch its first operational remote sensing satellite IRS-1A, it was decided to set up NNRMS under the aegis of the Planning Commission to prepare the country to use remote sensing and GIS for natural resources management. This was the genesis of NRIS.

You had to accommodate variety of inputs like remote sensing data, conventional maps and data on socioeconomic and infrastructure aspects. What were the challenges you faced in establishing an easy, accurate database and also in providing for timely updation under the NRIS standards and its environment?

NRIS began with a few pilot projects in 1986. In this exercise, we realised that data sources were many and each followed their own format. Fortunately, Survey of India provided a framework on which most of the data was referenced. Sharing data also posed a problem and in most cases we had to give an undertaking that the data would be used for 'official purposes only'. Village boundaries posed problems as they had to be taken from other sources which were not referenced to the SOI topographic framework. There were many other problems like missing villages or villages falling outside the district boundaries. Often the socioeconomic data could not be linked to the village map because of these reasons. Data on soils also proved difficult to obtain and we had to compromise on the scale of data to be used. Given this experience, we decided to establish a set of standards for the data to be inputted to the database and a set of standards for the database itself. This was later issued as the NRIS Node Design and Standards document and used for the operational NRIS implementation. The standards also laid down the update cycles for the datasets. These standards have now been upgraded to the NRDB Standards issued in 2005. These standards enabled us to outsource database creation.

Can you share with us the reasons for choosing ArcInfo to meet your project requirements?

We first wet our hands on a raster GIS developed by Roger Tomlinson which we obtained during a Indo-US seminar on remote sensing in 1984. We then tried out various commercial packages, some of which are no longer available, like PAMAP and SPANS. We also developed our own packages like ISROGIS and GeoSpace. In the final analysis, we reasoned that we needed a software that was feature-rich, used both vector and raster data and had a growth potential. An exhaustive survey then led us to ArcInfo.

And how well did the software meet your demands?

The software met our demands very well. There were some areas of concern. The Indian distributor, IDM and later NIIT took some time to get familiarised with the software and we often found that we were pacing with them! We began on mini computers as ESRI did not recommend workstations in 1986 when we started the pilot projects. We had to switch to workstations during Phase 1 and later to Wintel platforms in Phase 2 of NRIS implementation. This required retraining.

NRIS was visualised to be a network of GIS-based nodes covering data/information for districts, aggregated through states to the whole country. These nodes are repositories of natural resource information. Did you ever realise at that time that the whole process was building a prototype NSDI?

Yes, this realisation dawned on us as we started the standardisation process. The only difference is that we never thought of creating a metadata database as we did not envisage the use of data in an open access environment. However, we did start projecting NRIS as an SDI in-the-making.

Who were the other key members involved with this project?

We implemented the project through the state remote sensing centres. They were our partners sharing the costs and efforts. The DoS units (SAC, NRSA and RRSSC) provided the coordination and applications development support. Work was outsourced to industry where needed.

Now that the NRIS project has been successfully completed, what do you think is the road ahead for dissemination of natural resource information and services to the stakeholders?

The major roadblock to the dissemination of information through NRIS was the Map Policy or rather the lack of it. Now, with the policy in place, I do not see any difficulty in the access to the system by stakeholders. The NRDB is a step in this direction and should become an NSDI node serving up NRIS as well as other NNRMS datasets to government users.

I would like to see more work on Open Systems and the adoption of OGC standards like GML, WMS and WFS. I believe we need to start addressing the sensor web to make the database more dynamic and responsive to stakeholder needs. This is a crying need in disaster management.

I do have concerns but these are not in the area of technology. I feel organisations should stop worrying about protecting their respective turfs and enter into partnerships because this is the key to a successful SDI. We have a national metadata standard. This is a good step. We now need to concentrate on other standards, particularly thematic standards. The NRDB, proposed by DoS, is a step in this direction. This needs to be turned into a national standard with the partnership of other institutions.

Add X And Y Coordinates Of Features To Attribute Table

Description:

This VBA script adds two new fields X, Y to the attribute table of the selected point layer and fills the fields with the X, Y coordinates.

To use this script, associate it with a button in ArcMap. Select a point layer (point shapefile or point feature class geodatabase) in the TOC and click the button to which the script is associated. It will populate point shapefile or point feature class with X,Y coordinates.

Products: ArcView: VBA

Platforms: Windows

Minimum ArcGIS Release: 9.0

How to use:

1. Open a map document with more than one dataframe.
2. Copy-paste this procedure into ArcMap's VB Editor.
3. Run the procedure.

Description: This VBA script adds two new fields X, Y to the attribute table of the selected point layer and fills the fields with the X, Y coordinates.

To use this script associate it with a button in ArcMap. Select a point layer (point shapefile or point feature class geodatabase) in the TOC and click the button to which the script is associated. It will populate point shapefile or point featureclass with X,Y coordinates.

Products: ArcView: VBA **Platforms: Windows**
Minimum ArcGIS Release: 9.0

How to use:

1. Open a map document with more than one dataframe.
2. Copy-paste this procedure into ArcMap's VB Editor.
3. Run the procedure.

```
Option Explicit
Public Sub addxycoordinate()
    Dim pdocument As IMxDocument
    Dim play As ILayer
    Dim player As IFeatureLayer
    Dim pFC As IFeatureClass
    Dim x_field As IFieldEdit
    Dim y_field As IFieldEdit
    Dim pfeaturecursor As IFeatureCursor
    Dim pfeature As IFeature
    Dim penvelope As IEnvelope
    Dim x_coor As Double
    Dim y_coor As Double
    Dim index_X As Long
    Dim index_Y As Long
    Set pdocument = ThisDocument
    Set play = pdocument.SelectedLayer
    If play Is Nothing Then
        MsgBox "Select a single point layer
or point shapefile"
        Exit Sub
    End If
    Set player = play
    Set pFC = player.FeatureClass
If TypeOf pFC Is ICoverageFeatureClass Or
pFC.ShapeType <> esriGeometryPoint Then
        MsgBox "Select a single point layer
or point shapefile"
        Exit Sub


    End If
    Set x_field = New Field
    Set y_field = New Field
    With x_field
        .Type = 3
        .Name = "XFIELD"
    End With
    With y_field
        .Type = 3
        .Name = "YFIELD"
    End With
    pFC.AddField x_field
    pFC.AddField y_field
    Set pfeaturecursor = pFC.Search(Nothing,
False)
    Set pfeature =
pfeaturecursor.NextFeature
    While Not pfeature Is Nothing
Set penvelope = pfeature.Extent
        x_coor = penvelope.XMax
        y_coor = penvelope.YMax
        index_X = pFC.FindField("XFIELD")
        index_Y = pFC.FindField("YFIELD")
            pfeature.Value(indexX) = x_coor
            pfeature.Value(indexY) = y_coor
            pfeature.Store
            Set pfeature =
pfeaturecursor.NextFeature
    Wend
    End Sub
```

To download this script please visit : http://esriindia.com/Support/otss.htm

Adding Timer to ArcGIS Desktop VBA Application

Description: This script shows how to add a Timer to ArcGIS Desktop VBA application. VBA does not have a timer control so we need to use the Windows API SetTimer and KillTimer functions.

To use this script, add a windows form (frmTimer) in the VBA application and place two command buttons (cmdStartTimer and cmdStopTimer). Use the following script to create the timer control

Products: ArcView: VBA

Platforms: Windows

Minimum ArcGIS Release: 9.0

How to use:

1. Add a windows from in VBA Application and name is "frmTimer"
2. Add two command buttons to the frmTimer Form. Name the command buttons as cmdStartTimer and cmdStopTimer respectively.
3. Write the following code under ThisDocument of VBA application

```
Private Function MxDocument_OpenDocument() As Boolean
    frmTimer.Show vbModal
        End Function
```

4. Write the following code under windows form (frmTimer) of VBA application

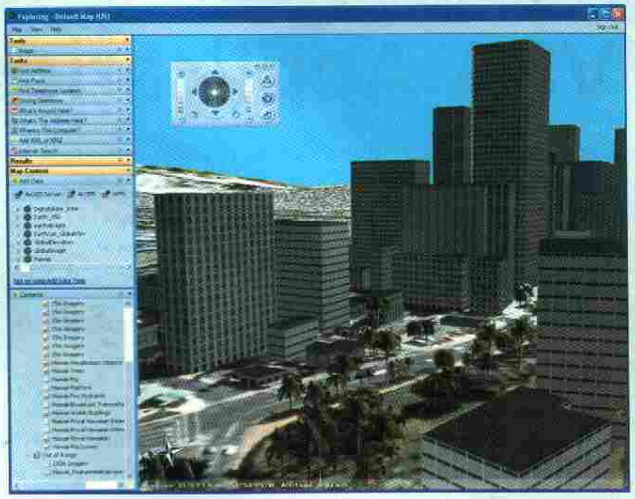
```
Dim lngid As Long
'Windows Api functions used to start and stop the timer
Private Declare Function SetTimer Lib "user32" (ByVal hwnd As Long, ByVal nIDEvent As Long,
ByVal uElapse As Long, ByVal lpTimerFunc As Long) As Long
Private Declare Function KillTimer Lib "user32" (ByVal hwnd As Long, ByVal nIDEvent As
Long) As Long
Private Sub cmdStartTimer_Click()
'in this sample 3000 is the number of milliseconds you want to time
'every 3000 milliseconds some event will occur
    lngid = SetTimer(0, 0, 3000, AddressOf TimerProc)
    If lngid = 0 Then
        frmTimer.lblTimerEvent.Caption = "Unable to initialize new timer!"
    Else
       frmTimer.lblTimerEvent.Caption = "Timer Started"
    End If
End Sub
Private Sub cmdStopTimer_Click()
    If lngid <> 0 Then
        Call KillTimer(0, lngid)
        frmTimer.lblTimerEvent.Caption = "Timer Stopped"
    End If
End Sub
Public Sub TimerProc(ByVal hwnd As Long, ByVal lngMsg As Long, ByVal lngid As Long, ByVal
lngTime As Long)
    ' hWnd: the window handle of the window
    '   associated with this timer.
    ' lngMsg: the WM_TIMER message (275, or &H113)
    ' lngID: the Timer's identifier (the same value
    '   returned by SetTimer)
    ' lngTime: milliseconds since Windows started (the
    '   same value as returned by the GetTickCount
    '   API function)

    ' Do whatever you want done every <n> milliseconds
    ' here:
   frmTimer.lblTimerEvent.Caption = "Event Occured"
End Sub
```

Scripts developed by: Dheeraj Kumar Varshnay, ESRI India Consulting

To download this script please visit : http://esriindia.com/Support/otss.htm

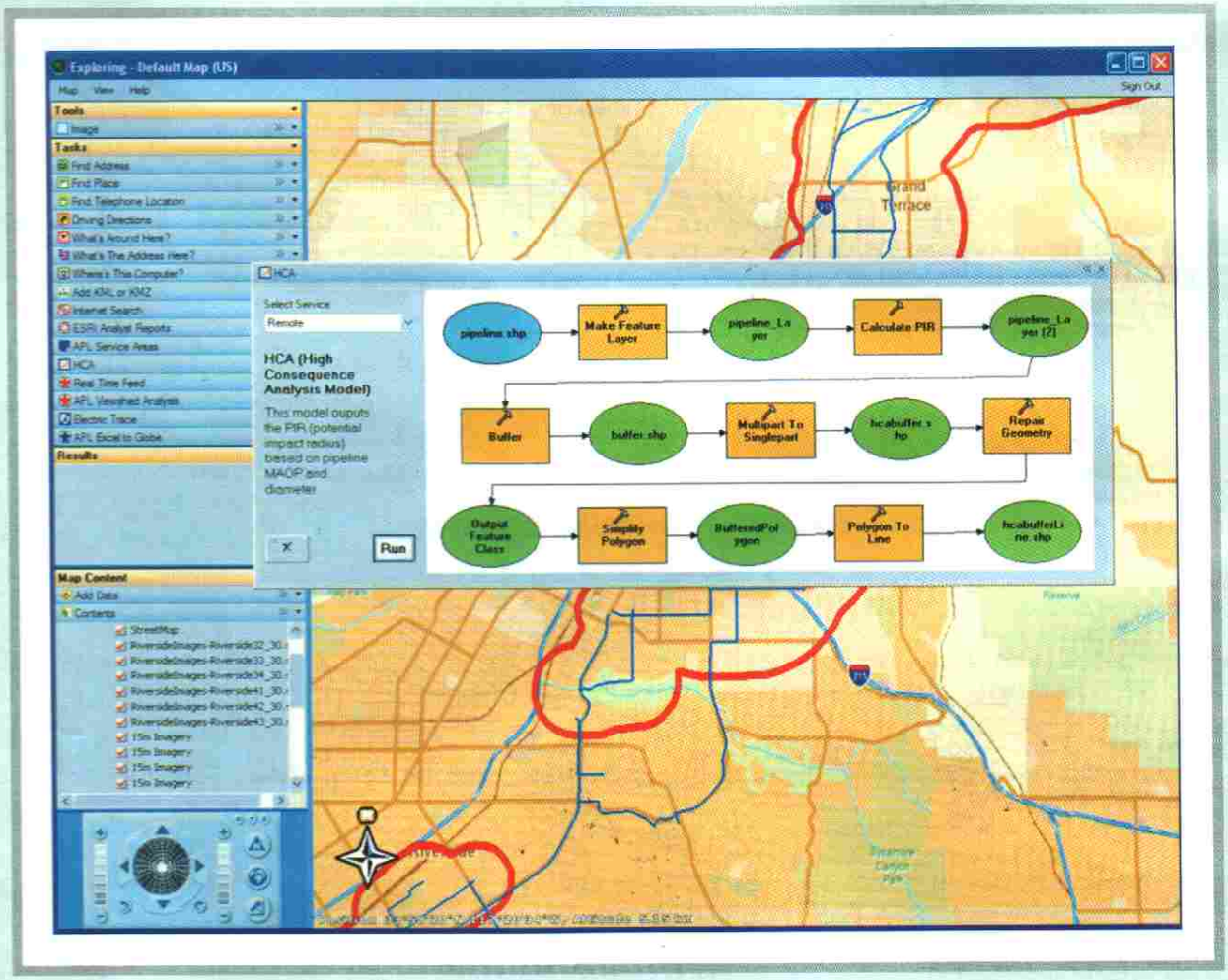
ArcGIS Explorer

ArcGIS Explorer is a new client for ArcGIS Server. Explorer allows users to easily use GIS services in an easy-to-use non-GIS centric context. Explorer is free, and freely distributable, and provides a compelling way to offer "GIS for Everyone."



ArcGIS Explorer integrates the rich world of GIS datasets and server-based geoprocessing applications. It does this by accessing the full GIS capabilities of ArcGIS Server including geoprocessing and 3D services.

It can be used to access, integrate, and utilize GIS services, geographic content, and other Web services. ArcGIS Explorer can also be used with a variety of other GIS services such as those published using ArcIMS, ArcWeb Services, Web Map Services (WMS), and other Web services. In addition, ArcGIS Explorer can use local data such as shapefiles, file geodatabases, KML, JPEG 2000, GeoTIFF, MrSID, IMG, and other image formats.

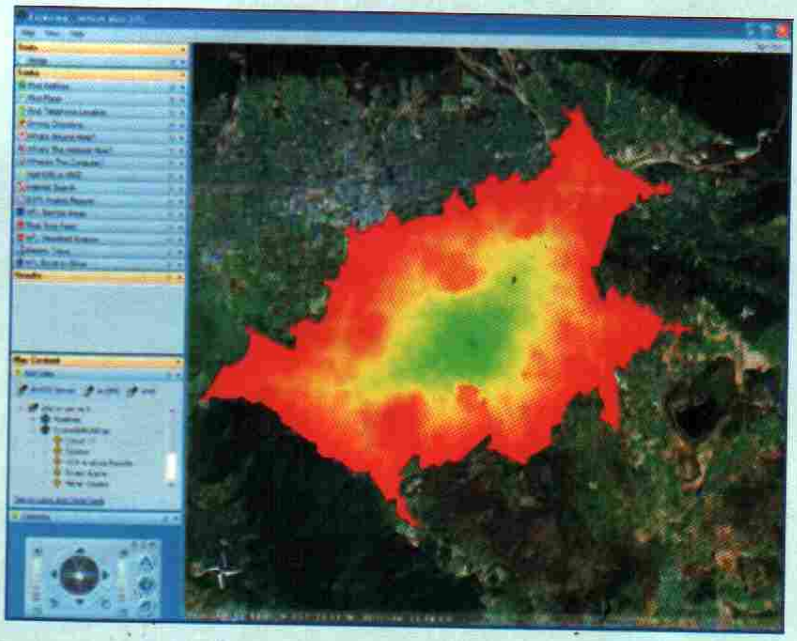


The most significant aspect of ArcGIS Explorer is its ability to leverage any ArcGIS Server-based capability through custom tasks. By default the application includes commonly needed tasks, and additional tasks will be downloadable from a library of tasks published from the ESRI web site. Users can pick and choose which tasks they want, and can also create custom tasks. Custom tasks connect to ArcGIS Server, and can perform complex geoprocessing or modeling functions such as demographic reporting, site analysis, service area analysis, and use other GIS capabilities and models.

ArcGIS Explorer is a platform for integrating and publishing GIS web services. Its not just an exploration tool, it's a powerful way to deliver and publish ArcGIS capabilities to a whole new world of users.

Key Features Of ArcGIS Explorer

- Free, lightweight, downloadable (< 25MB)
- 2D Map and 3D Globe display and navigation
- Easy to use and familiar user interface
- Users can save maps and results and share/email them
- Centralised map services
- Customisable user interface ("Skins")
- Can access services from:
  - ArcGIS Server
  - ArcIMS
  - ArcWeb Services
  - OGC WMS Services
  - Other web services
- Supports adding local data:
  - Shapefiles
  - Images (JPEG 2000, GeoTIFF, IMG, more...)
  - KML, KMZ
- Other sources can be supported via custom Tasks
- Includes ready-to-use tasks and tools:
  - Transparency, Swipe, Elevation
  - Measure, Identify
  - Find Address
  - Find Place
  - Driving Directions
  - And more...
- User can choose which tasks appear
- GIS Analysts can create custom tasks that use ArcGIS Server capabilities:
- Geoprocessing, modeling, more...
  - Authored using ArcGIS Desktop, published using ArcGIS Server



Navigation in ArcGIS Explorer is simple. It supports flying over the map view, rotating, tilting, continuous pan, and dynamic zoom. You can also change the transparencies of the layers of information you see on the map and swipe any layer for rapid comparison of data.

ArcGIS Explorer is useful for people who collaborate and share information with others to form a common operating picture. It offers a fast, simple way to explore geographic information covering the entire world, combine it with local data, and perform queries on the underlying data.

For more information on how you can discover a world of information with ArcGIS Explorer, visit www.esri.com/arcgis-explorer.

AAI Selects ESRI Enterprise GIS Technology For Height Clearance Compliance System

Redlands, California — Airports Authority of India (AAI), the national agency responsible for the management and maintenance of the country's civil aviation, both on the ground and in the air, has awarded the No Objection Certificate Application System (NOCAS) project to NIIT Limited, parent company of NIIT-GIS Ltd. (ESRI India).

A No Objection Certificate (NOC) for height clearance issued by AAI is required for construction projects, such as high-rise buildings or communications masts that fall within 20 km of an airport. The NOCAS project automates the prioritisation and processing of NOC applications based on criteria established by AAI, which will greatly streamline the approval process.

The enterprise-wide geographic information system (GIS) application will be Internet based with a link available at the AAI Web site. Two categories of users will have access to the site: NOC applicants and employees involved in the certification process. ArcGIS Server products will be installed on the AAI Web server and will be linked to a database server hosting ArcSDE and Microsoft's SQL Server. The application will be written using ArcGIS Server Application Development Framework (ADF) for .NET and will make use of ArcObjects, a suite of mapping and GIS components. Users will access the application through Internet browsers.

> Selection comes after an extensive process of open tender, technical, and financial short-listing

"ESRI India is very pleased that AAI has selected ArcGIS Server technology as its GIS component for the No Objection Certificate application and NIIT Technologies Ltd. to create and implement the application," says. Rajesh C. Mathur, president, ESRI India. "The decision to select ESRI technology for the agency's enterprise GIS will help make its application and related data available to many internal and external users in a very secure and accurate environment with a low cost of ownership."

In addition to ArcGIS software and training, the implementation will include GIS services from NIIT Technologies and ESRI India.

Symbiosis Institute of Geoinformatics

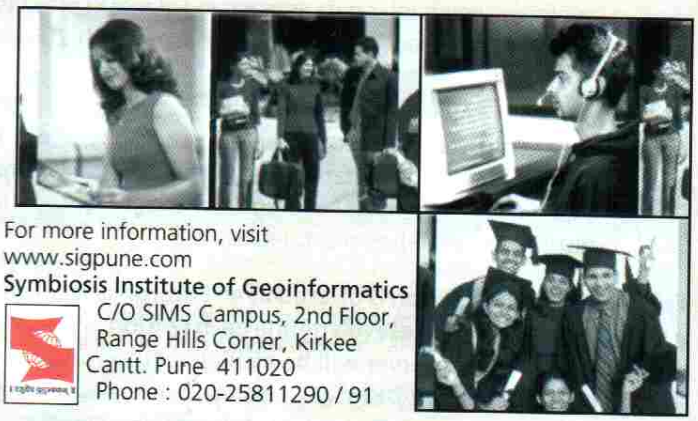
Symbiosis was established in 1971, primarily to promote an understanding between Indian and foreign students through education. Symbiosis runs thirty four academic institutions in various disciplines such as management, law, computer, mass communication, arts, commerce, telecommunication and even kindergarten, primary and secondary schools.

There are over 90,000 students in Symbiosis, students from over 40 different countries and from all states of India are presently pursuing studies in various institutes of Symbiosis. At Symbiosis, excellence is passion.

Symbiosis Institute of Geoinformatics (SIG) is one of the younger members of the Symbiosis group, India's symbol of educational excellence for the past 35 years.

The two years full time PG Masters Programme in Geoinformatics launched by SIG, a member of internationally well-known Symbiosis Society for its quality training and brand name in the field of education, aims at creating a potent reserve of experts in the field to meet the future challenges.

- Rewarding careers in GIS, remote sensing, GPS, photogrammetry, IT
- AICTE approved programme. Also approved by UGC for affiliation to Symbiosis International University
- State-of-the-art computing facilities
- 100% placement record
- Recruiters among top companies like ESRI, TCS, Cybertech, Reliance, Magnasoft, Fugro, Speck Systems etc.



For more information, visit
www.sigpune.com

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ESRI Honours SAG Winners

2006 Special Achievement in GIS

ESRI, the world leader in GIS software, presents the Special Achievement in GIS (SAG) award to organisations and agencies that display dedication and commitment through their use of GIS technology. The winners of the award are chosen out of more than 150,000 organisations worldwide.

"The SAG awards celebrate the achievement and vision of innovators in the GIS field," says Jack Dangermond, ESRI president. "Each winner brings benefits to their communities and influences others to do the same."

Two of our Indian users namely, The Central Mine Planning and Design Institutes, Limited, (CMPDIL) and Tamil Nadu Forest Department were recognised for excellence in the geographic information system (GIS) field with a 2006 Special Achievement in GIS (SAG) award at the Twenty-sixth Annual ESRI International User Conference in San Diego, California.

Some of the previous SAG award winners from India include Space Application Centre, Geological Survey of India, National Informatics Centre, Survey of India, Government of Andhra Pradesh and Reliance Group of Companies.

This year ESRI also announced "Distinguished Service in GIS Award" for making a difference in the lives of others. The award was received by Dr. N Vijayaditya, Former Director General, National Informatics Centre, Government of India.

ArcGIS Server

▶With the release of ArcGIS 9.2, ArcGIS Server is offered in six new product options distinguished by functionality (Advanced, Standard, and Basic) and by scalability (Enterprise and Workgroup).

- **Advanced:** ArcGIS Server Advanced is designed for GIS organisations that want to provide a central, server-based GIS for distributing GIS services across the organisation or over the Internet. It provides spatial data management, visualisation (both 2D and 3D), and spatial analysis capabilities.
- **Standard:** ArcGIS Server Standard is designed for GIS users who want to provide a central, server-based GIS for publishing geographic data as maps and globes. It provides spatial data management and visualisation (both 2D and 3D) capabilities.
- **Basic:** ArcGIS Server Basic is designed for GIS users who want shared access to geographic data. It provides core geodatabase management tools and technology for data storage, management, and distribution (Web-based data replication).

Each ArcGIS Server edition is offered at an Enterprise level and a Workgroup level. These levels define each edition's capacity. All editions of ArcGIS Server will be available at a workgroup level with an embedded DBMS (SQL Server Express) and at an enterprise level for use with various enterprise class DBMSs.

- **Enterprise:** The Enterprise level of ArcGIS Server supports an unlimited number of users via either direct connect or connection to an application server. It offers DBMS support for IBM DB2, IBM Informix, all editions of Microsoft SQL Server, and Oracle. It has no data or memory limits.
- **Workgroup:** The Workgroup level of ArcGIS Server supports a maximum of 10 direct connect users. It includes an embedded DBMS (Microsoft SQL Server Express). It has a data limit of 4 GB and a memory limit of 1 GB.

▶With the 9.2 release, ArcSDE is included with ArcGIS Server and is no longer sold separately. ArcIMS will continue to be available as a separate product.

▶Support of SDE 9.2 is NOT planned for ArcView 3.x DB Access for Windows based on the ESRI Product Life Cycle Policy.

▶The new Web Application Developer Framework (ADF) is a major improvement included with ArcIMS 9.2 and ArcGIS Server 9.2 (Advanced and Standard). It is possible to build applications with the Web ADF that work with either ArcIMS or ArcGIS Server.

ArcPad

▶New Mobile GIS ADF for developing lightweight applications on handheld devices - Supports integrated GPS, quick attribute updating during field inspection, field data collection involving the creation of features, and wireless synchronisation.

▶ArcPad 7 supports ArcGIS symbology and style sheets.

ArcGIS 9.2 Desktop

▶ArcGIS 9.2 Desktop can run ArcGIS Engine applications without the need to install ArcGIS Engine Runtime.

▶New extensions to ArcGIS Engine Runtime

- Data Interoperability
- Schematics
- Maplex
- Tracking

▶The geoprocessing framework and ModelBuilder now have the ability to perform looping and iteration. This enables the output of a process to be the input to a previous process in the same model.

▶Animation tools now available in ArcMap - Ability to create, play back, and export animations.

- Support for time-based animation so the display of multiple layers on same time interval can be synchronised.
- Graphs can be animated - all data can be displayed, graphed, and animated.

▶CAD layers can now be georeferenced using the Georeferencing toolbar, which facilitated to move, rotate and scale your CAD layer using the mouse, and create control points, etc.

▶Support for PDF layers gives facility to export maps to PDFs in which map layers and graphics can be turned on and off.

▶Publisher & ArcReader - Support for Maplex so maps with high quality labelling can now be viewed and printed from ArcReader.

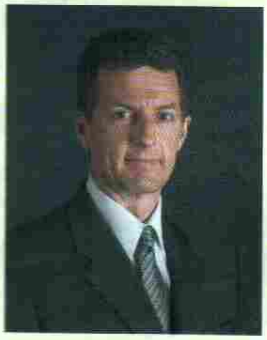
- New ink-based mark-up toolbar for red-lining.
- Ability for ArcReader users to modify the map title that appears on page layout before printing.

ArcGIS Image Server

▶ArcGIS Image Server 9.2, much-anticipated new solution for fast and dynamic image distribution, is now available.

- ArcGIS Image Server 9.2 Redefines Dynamic Imagery Distribution.
- ArcGIS Image Server is integrated with ArcGIS Server, which allows the data to be distributed to Web-based, mobile, and Open Geospatial Consortium, Inc.-compliant (OGC) clients.
- Users can publish GIS-ready imagery directly to a large number of clients. In addition, server-based processing enables imagery to be quickly published as

Simulation And Modelling Geoprocessing With ArcGIS 9.2



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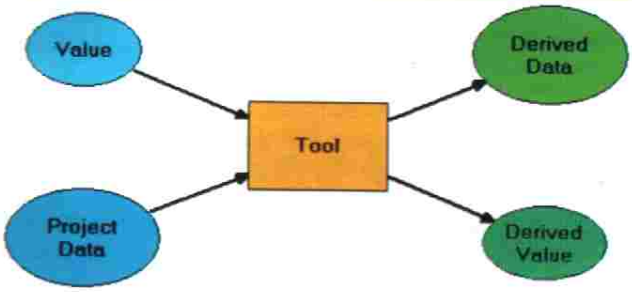
Introduction

This article overviews the main geoprocessing capabilities of ArcGIS and introduces the major new features in the 9.2 release, focusing on spatial analysis and simulation modelling.

ArcGIS has had geoprocessing capabilities for many years. A new framework and set of tools was introduced to support spatial analysis and modelling at the ArcGIS 9.0 release. In ArcGIS we call spatial analysis and modelling geoprocessing (or geographic processing). This term covers everything from automating data compilation and management, to 'classic' geographic analysis (overlay processing, proximity analysis, etc.), Projection/coordinate transformation, spatial statistics, and domain specific analysis 3D, surfaces, network, raster, geostatistics, linear referencing, cartography, etc. At 9.2 the existing geoprocessing framework and toolset has been extended to support simulation modelling.

Overview of geoprocessing

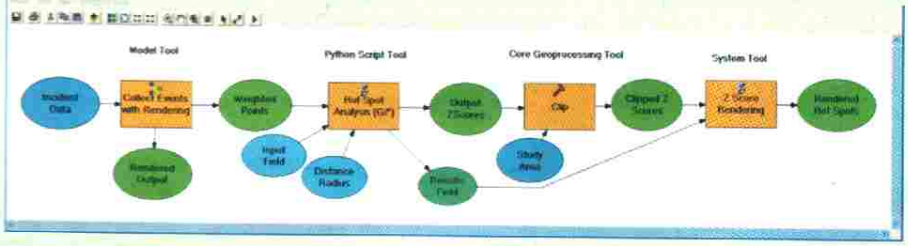
There are really two parts to ArcGIS geoprocessing: the framework and the tools. ArcGIS has a fully developed framework for performing geographic processing. The fundamental model is based on the simple idea of data transformation.



Data + Tool = Data. Parameter values can be used to control the interaction between the data and tools. Data and tools can be strung together to create quite sophisticated models. Here is a relatively simple model for calculating hot spots (clusters) in crime events.

Models can be created using visual programming (drag 'n drop data and tools on to a canvas, connect them together, specify parameters and run) and scripting (Python, VB, etc.). The geoprocessing framework is available ubiquitously throughout ArcGIS (on the desktop, as server web services, and embedded in a desktop run-time engine).

There are hundreds of tools in the ArcGIS 9.2 release that are grouped into toolboxes. Many of the toolboxes are in the core, and some are added when extensions (3D, Spatial, etc.) are licensed. Any user can develop their own tool (by combining existing tools, or adding new code).



This apparently simple approach to geographic processing belies a very powerful and sophisticated capability for spatial analysis and modelling. When combined with the power of ArcGIS it offers some interesting options for analysts and modellers.

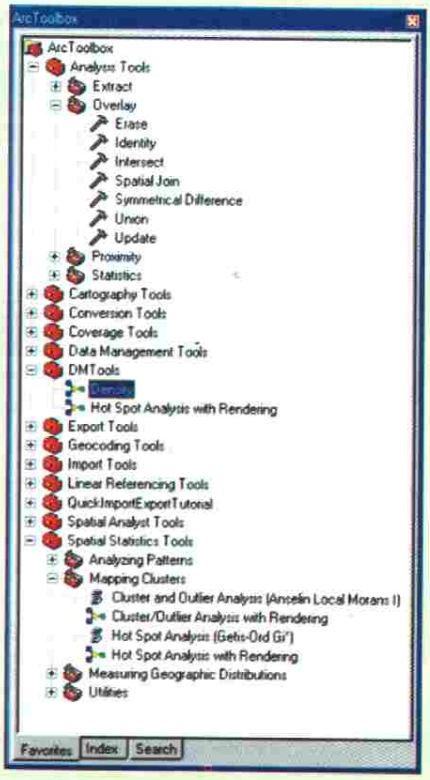
Data management for very large, multi-user data sets. In the past, spatial analysis and modelling projects have used relatively small data sets (thousand of features, grids with less than 100,000 pixels) because of the difficulty in managing data. ArcGIS's geodatabase takes care of this and can store all data in a DBMS or file system..

Tools for data conversion, transformation and integration. ArcGIS 9.2 offers a full spectrum of basic utility tools to convert, transform and integrate data (change projection, convert the spatial base from, say, polygon to point centroid, edge match separate tiles, etc.) which takes a lot of the hard labour out of geoprocessing.

Mapping and visualisation environment. The ArcMap and ArcGlobe 2D/3D mapping and visualisation environments support data exploration, scientific visualisation and communication of final outputs. New 9.2 scientific charting and graphing functions also help with data understanding and visualisation. ArcGIS allows GIS to be inserted into policy frameworks so that it can be effectively consumed.

Scripting and customisation. The geoprocessing framework provides support for scripting models using both Python and .Net / Java languages. This gives programmers precise control over model execution and allows for easy extensibility.

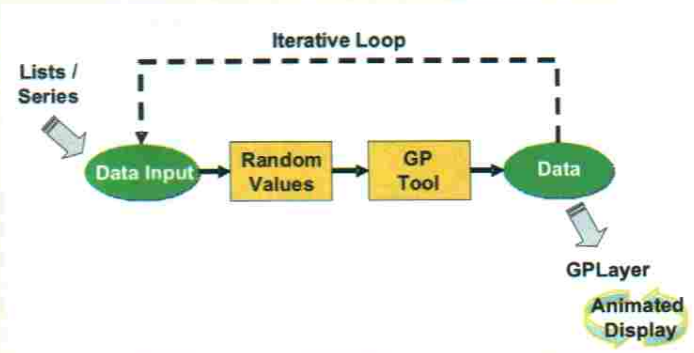
Integration with external systems. Recognising that it is not sensible to model everything, every time inside a GIS, the geoprocessing framework has lots of options for close - and loose - coupling with external systems such as SAS, SPSS, R, and any open data source or callable program.



In summary, ArcGIS offers a simple, but very sophisticated geoprocessing framework and set of tools. Prior to 9.2, these tools were really only able to be applied to static map style spatial analysis and modelling. Next let's look at how simulation and advanced modelling can be performed with ArcGIS 9.2.

Simulation modelling

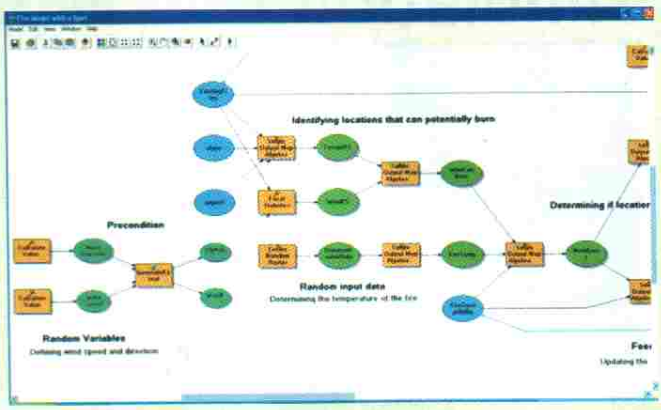
One of the key goals for geoprocessing at ArcGIS 9.2 was to extend the existing framework beyond the bounds of static cartographic-style, descriptive modelling into the world of dynamic, stochastic, process modelling. Simulation modelling has many applications in GIS including modelling errors (what is the effect of errors in a DEM on the derived stream network?), sensitivity analysis (how sensitive is my housing suitability model to the slope parameter in the terrain input layer?), or what-if scenarios (how will a fire move across a landscape, based on information about land cover, terrain and wind direction?). The following new capabilities have been added to ArcGIS 9.2 to support this type of work:



Branching. Branching has in fact been available for several releases, but it is covered here because it is so useful in dynamic simulation modelling. Branching can be used to control the flow of a model. ArcGIS includes both If-Then-Else logic and precondition tests that output True/False. For example, in a fire model If-Then-Else logic can be used to branch depending on whether an area is forest or grassland.

Iteration. Iteration is a general term that describes how many times a model (or part of a model) will run. There are several ways to control iteration including looping (execute a model n times), conditional logic (looping until value=true), and running a model for all values in an input list.

Feedback. This is the ability for a downstream process to influence an upstream process. For example, as a fire burns, the amount of fuel will reduce until it is all used up and the fire can no longer burn. The amount of fuel can also control the temperature (and therefore the rate at which the fire can burn). During the first run of a fire model, the amount of fuel is reduced and this can then feedback into the next iteration to control burning / subsequent burning.



Random functions/values. Both random functions and values can be incorporated into ArcGIS 9.2 models. For example, the location of a fire can be determined using a random function to generate a raster with a random point. A random value can be generated using one of the nine supported distributions (and a seed value) to simulate sparks jumping from a fire to start another fire.

List/series processing. ArcGIS 9.1 only supported one data layer as input to a tool. ArcGIS 9.2 additionally supports both lists and series of data values as input. Lists force all downstream processes to execute once for each value in the list, whereas series force entire model execution once for each input value.

Result visualisation. Iterative models typically generate one output layer for each iteration. To mange and visualise model output two new capabilities have been added to 9.2: geoprocessing layers and animation. A geoprocessing layer allows the symbology for an output to be specified once and then reused for each subsequent iteration. Each time the model runs the output is written to the same layer, over-writing the previous output. An alternative approach is to write each iteration out to a separate layer. If the output layers of a model are of type raster then the layers can be managed as a raster catalog (a collection of rasters). The animation framework at 9.2 can be used to visualise multiple layers in either 2D or 3D. Animations can be displayed directly onscreen and can be saved as animated movies such as AVIs.

Several of these capabilities are shown as screenshots that show two parts of a fire model. Random variables are used to define wind speed and direction (using weights in a kernel), random values are used to represent fire temperature, feedback connectors (blue lines) provide a control over the number of iterations that vegetation can burn, and branching with random variables determines when sparks jump from a fire to initiate new sub-fires.

In summary, ArcGIS 9.2 has many new capabilities for creating dynamic process models that represent or simulate aspects of real world ecological, environmental, and social systems which focus on geographic patterns and processes. Both the framework and the tools are generic and can be applied to a wide range of physical, environmental and social geographic models.