NEWS

FEBRUARY MEETING

Media Centre, University of the South Pacific, 2:30 pm, Tuesday, 13 February 1996

Agriculture Department

- Soil layers for Viti Levu have built up (soil type boundaries).
- Now moving to Vanua Levu soil layers.
- The data capture is based on the old map sheet coverage, which is not referenced to Fiji Map Grid.

Department of Environment

- An inventory of existing databases (Meta-database) is being prepared through visits to relevant organisations.
- A network is being installed in the department.

Fiji Land Information Support Centre (FLIS)

- All cadastral maps captured, they be produced as hard copies.
- The 1976 and 1986 boundaries from Bureau of Statistics are digitised and the 1996 boundaries will be digitised by end March.
- Pilot project mapping hazards.
- Training 20 students from FLIS agencies will attend the USP Diploma in GIS course this year.
- The final report by Chungchui He of the Remote Sensing Regional workshop held in February 1995 has finally arrived after 12 months. Copies will be distributed to participating organisations. Again, the relevance of this UN organisation was questioned in view of another seminar planned by ESCAP for 1996.

Fiji Posts and Telecommunications Ltd (FPTL)

- The management has approved the implementation of a GIS to assist in the operations of the business and technical sectors of the company.
- The specifications for this GIS are being created.

Mineral Resources Department (MRD)

- Representative from AusAID is in Suva as part of the planning for an airborne geophysical survey which will include magnetic data acquisition. The survey will cover the big islands of Fiji and Bligh Strait using fixed and/or rotary wind aircraft with track separation of 400 and 800 metres for land and sea respectively. The objective of the survey is to provide information for promoting mineral exploration by Australian mining companies. Organisations interested in additional instrumentation should contact MRD. The timing for the planning phase is April/May 1996 while the timing for the survey may be 1997.

Management Services Division (MSD), Forestry Department

- Area calculation (forest types and forest functions) completed, Kadavu will be completed soon.
- ARC-INFO map editing for Galoa, Naboutini and Sawakasa plantations have been completed.
- It was impossible to obtain copies of 1:25,000 aerial photographs for plantation areas in Vanua Levu. These plantations are now mapped from 1:50,000 photographs. Data capture (Visopret) for Korotari, Saqani is completed. Mapping for Navonu plantation is in progress.
- Cost of SPOT imagines has increased from $2750 AUS to $3400 AUS (including special acquisi-

GIS & REMOTE SENSING NEWS

FIJI USER GROUP, Number 14 (9601), May 1996

Welcome to the first newsletter for this year and the usual apologies for not meeting the deadline which was the end of April. The excuse this time has been the Internet. That ubiquitous tool which offers so much in access to information yet is so elusive to those of us in the Pacific Island countries.

We hope all of that will change within the next few months and we intend to keep you informed of developments. Many of us now have e-mail and are exploring the mailing lists which embrace a host of subjects. From the bizarre to the most esoteric and somewhere in that spectrum lies those that address GIS and Remote Sensing issues. There is an article by Bill Thoen, which has been reprinted with permission form GIS World, which explains how to subscribe and how to unsubscribe to these lists. This article is a must for new users exploring Internet e-mail for the first time and hopefully you will be able to access some of these lists within the near future when you get connected. The most useful list for us at SOPAC is the MapInfo offering and as that's the most popular application in the Pacific, that's where you may want to start.

Then there's the Web for those out there with full Internet and Prakash Narayan, from Fiji, and working at ORSTOM (the French research institute) in Noumea, has provided a starting list of Web sites. Prakash will be contributing on Remote Sensing issues through a series of articles from basic principals to advanced applications.

We, like many organisations, have produced our Web site and with many pages under construction are mailing it around for comments. This whole newsletter has been transferred to Adobe Acrobat so that you can access it in when we are all connected. As previously mentioned, we have been delayed by the Internet, but it's not the Internet that's the delay it's getting connected which has consumed so much time. The objective is to set up a more efficient means of accessing information in the rim countries, distilling that information and distributing it more effectively in the region.

In addition to the Internet, we have articles on a wide range of subjects, from prospects for sustainable development of natural bamboo resources using GIS & RS techniques, through a help engine for MapInfo developers to an on-line Environmental Manual for Power Development in the South Pacific. Osea Tuinivanua from MSD and currently undertaking research in Remote Sensing has an article on improved classification techniques for various forest cover types and there's much more. Again, we welcome contributions from national, regional and international users. Yes, you can reach us by Internet - see back page for the addresses!

tion).
- Special acquisition of MSD-Forestry is continuing for SPOT scenes 436-385 and 437-385 (north east of Vanua Levu) and for data of Kadavu.
- In Germany a company has scanned the river system and the road network from transparencies of the new topographical map sheet series of the Lands Department. For areas which were not covered by the new map series the corresponding transparencies of the old series have been assembled before scanning. This data is available on CD ROM and will arrive soon in MSD-Forestry.

Native Lands Trust Board (NLTB)
- Data has successfully been translated from Informap to Infocad and the process will be presented at the next meeting.
- While the translation between the old and the new GIS applications is successful, there is no guarantee that the new application will be able to provide translations with can be used by other organisations in Fiji.

South Pacific Applied Geoscience Commission (SOPAC)
- SOPAC is undertaking a study of shore-zone vulnerability to sea-level rise and other climate-change impacts in the Suva area, on behalf of Fiji Environment and Mineral Resources. As part of this project, a biophysical shore-zone classification has been developed in MapInfo. Future additions to the GIS will include survey data on harbor bathymetry, nearshore and foreshore tidal flat, reef, and beach morphology, and backshore elevations as a basis for determining the inundation, overtopping, and erosion potential of high tides, storm surges, and storm waves under various sea-level rise scenarios. The combined GIS data will be then be used to determine the spatial distribution of shore-zone vulnerability and adaptation requirements.
- In addition, the US public-domain GRASS software has been successfully implemented for digital rectification and overlay of air photographs and ground-survey data in projects at Tarawa (Republic of Kiribati) and Natadola Beach (Viti Levu). A similar application is planned for the Suva shoreline study. GRASS has also been used to rectify raster airphoto images before importing them into MapInfo, enabling display of the raster image in the selected MapInfo projection.
- New software received includes:
  * MapInfo and MapBasic 4.0.
  * Discover 1.2, a MapInfo add-on application for mining exploration.
  * Virtual Tablet Interface 3.1 for digitising under MapInfo.
  * R2V an application to convert scanned raster images into vectors as an effective alternative to hand digitising mapsheets. This will be used in the Suva project.
- The Internet e-mail MapInfo mailing list has been monitored for the past 6 months and all relevant information has been stored in an Access database indexed by subject. The information includes extensive solutions, especially MapBasic code. Users of MapInfo with any problems users were invited to contact SOPAC.
- The next GIS and Remote Sensing newsletter will contain information about subscribing (and unsubscribing) to GIS related Internet e-mail mailing lists which include MapInfo and Idrisi.
- Discussions have been held with AusAID regarding the planned aeromagnetic survey. (see MRD updates).
- A GIS system is being developed for Department of Environment under the direction of a specialist from New Zealand (see DOE updates).

Public Works Department (PWD)
- AusAID is prepared to fund equipment which includes software applications but when requested for 4 copies of MapInfo, advised that Arc/INFO would be better. SOPAC was requested to inform AusAID of the unsuitability of Arc/INFO.
- Digitising of water mains system is underway.

Lukemine Enterprises
- NLC has purchased a Trimble Geoexplorer GPS.
- MRD has acquired two Trimble Geoexplorer GPS under JICA funding.
- FEA has purchased a base station and a Pro XL GPS unit for sub-metre accuracy surveys.
- Wood & Jepson has acquired a GPS Total Station with millimetre accuracy for capturing the centreline data of a 300 Km roading project.
- Four users have purchased or upgraded to MapInfo Professional 4.0.

PRESENTATIONS

Chang Surveyors presented their consutancy for Fiji Sugar Corporation. Sugar cane fields have been mapped by GPS survey and imported to MapInfo. The high accuracy of the survey was possible through the Trimble base station at MSD-Forestry which povides metre accuracy as apposed to inaccurate results due to selective availability. The objective of the project was to improve effiency of the idustry through use of GIS. Man-

■ *by Osea Tuinivanua, MSD-Forestry*

Improving Fiji's Rainforest Classification Using Digital Satellite Images

Abstract

The National Forest Resource Inventory (1991 - 1993) successfully classified Fiji's Rainforest into Scattered, Medium and Dense Forests using Landsat TM (Thematic Mapper) data. More detailed forest content information is necessary for further forest typing, forest change and monitoring. Using the same TM data, a further signature analysis and land cover interpretation was made on the Navua water catchment to determine the possible spectral differences within the residual logged and unlogged forests. The spectral differentiation of the selected forest types were maximised by utilising the infra-red bands of the TM data.

Introduction

Classification of Fiji's natural rainforest is necessary to provide a more detailed understanding of land use and water run off to provide information of management of this resource. The classification is part of the continuous effort to stratify our rainforests as far as possible using digital satellite images. For the purpose of this report only Landsat TM application has been described. Combination and comparison with SPOT data will be provided at a later stage.

Test Area

The test area is part of the upper Navua Catchment (103,000 ha) in Fiji. The area has been subjected to extensive selective logging in the past three decades and this logging is continuing. The area represents a mixture of production and

agement representative from FSC advised that initial work was very promising in assisting FSC in identifying areas where improvements can be made. Thanks to FLIS, NLTB, SOPAC. A full report will be provided by the consultants in the next GIS & RS newsletter.

A report was provided about improvement of stereo mapping at Lands Department.

DISCUSSION

The Agriculture Department suggested that orthophotos should be produced from available Lands Department aerial photographs with the available digital terrain model (DTM) from the Forestry Department.

MSD advised, that a DTM at 1:50,000 scale with a picture element size of 25m is not accurate enough to produce the orthofotos and that information such as road network, river system and urban areas are mapped by the Lands Department while the forest cover is mapped by the Forestry Department. Agricultural forecast is best archived through recent satellite scenes.

MARCH MEETING

Department of Environment, 2:30 pm, Tuesday, 5 March 1996

Agriculture Department
- Field work in Vanua Levu for Fiji's Soil Map.

Department of Environment (DOE)
- Monitoring of other relevant groups for data base linking is ongoing.
- Franck Martin (SOPAC) setting up a data base system in the department.

protection forests under the LRD[1] forest typing and had been extensively logged before the TM data acquisition.

The test site which is a subset of the test area has been characterised by short and very steep slopes generally along the creek origin and the main river banks. The logged forest has been dominated by non-commercial species and undersize or defective commercial tree species. Natural regeneration of commercial species is variable and dependent on the extent of logging intensity, slopes and aspects and soil types.

The logged area had significantly lost its forest structure. The upper storey is dominated by single or groups of scattered stress-trees struggling to adapt from sudden exposure, disturbed site and other climatic conditions. The lower storey represents a mixture of light demanding trees species composing of pioneer shrubs, non-commercial tree species and residual forest component. The varying intensity of logging has changed the density of the residual forest thus resulting in different forest density of logged forests.

Training Areas

Training areas are small areas of typically 200 x 200 metres where field surveys are undertaken to provide spectral reference data for subsequent analysis. These were located in the field with the assistance of Differential Global Positioning System (GPS) to ensure accuracy of better than 5 meters. At this stage, 12 training areas were established to enable the differentiation of some of the LRD forest typing.

TM Data

The TM data used was recorded in the morning hours of 25 December, 1991. The test area is a subset of scene 075/072 of Landsat 4 TM data. TM bands 1 to 5 and 7 were used in the analysis.

Data Analysis

A comparison of the statistical parameters was made on TM_3, TM_4 and TM_5 for the 12 training areas to evaluate the initial separability of the selected forest cover. Apparently the three TM bands had shown comparable differences in the evaluation. However, the standard deviations were greater with TM_4 +/- 4 > TM_5 +/- 3 > TM_3 +/- 1.

Similarly, a signature analysis involving the 12 training areas was evaluated to demonstrate the separability of the se-

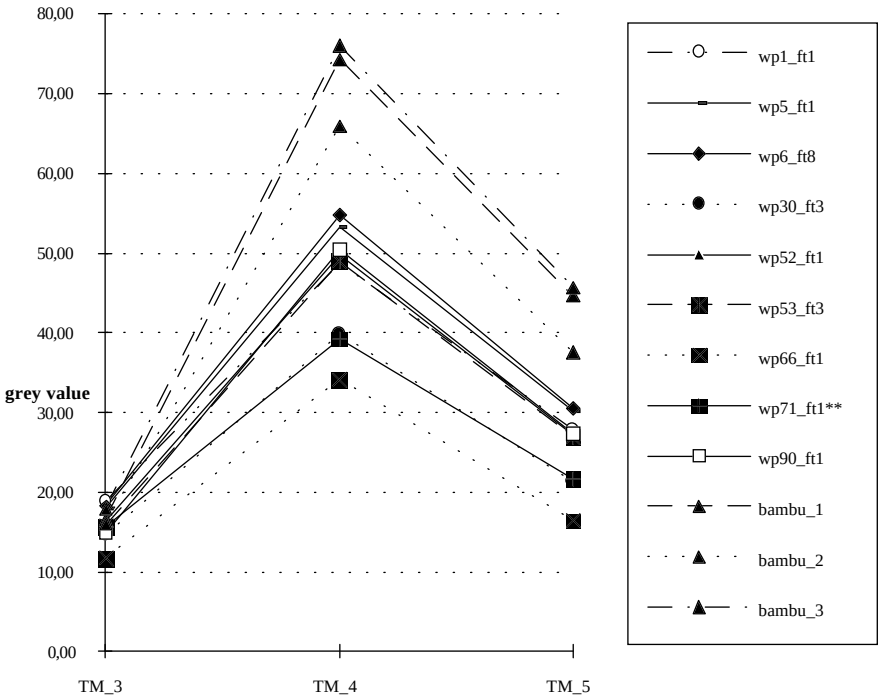


Figure 1. Signature Mean Plot of the Training Areas.

[1] *LRD maps are the outputs of the last forest inventory which was undertaken 1969-1971.*

Fiji Electricity Authority (FEA)
- See Presentation.

Fiji Land Information Support Centre (FLIS)
- From the cadastrial mapping system sheets at 1:5,000 and 1:10,000 can be extracted.
- The 1986 boundaries were not received from the Bureau of Statistics, so were not digitised as planned.
- 29 students from FLIS agencies are under training at USP.
- There will be a NSDA/RESTEC group in Fiji to plan the Remote Sensing workshop workshop to be held in Suva later this year.

Fiji Posts and Telecommunications Ltd (FPTL)
- Preparations of GIS purchase are ongoing.

Mineral Resources Department (MRD)
- The department undertakes a training course in FoxPro (a relational data base system).

Management Services Division (MSD), Forestry Department
- Area calculation (forest types and forest functions) completed, including Kadavu.
- ARC-INFO map editing for all hardwood plantations in Viti Levu except Colo-i-Suva and Nukurua.
- Field checks for the forest change detection (article in the last GIS & RS newsletter) shows that the estimated rate of forest loss is to high, instead of 10% it will be around 5%.
- Mapping of logging areas at 1:10,000 scale continues.
- It is possible, know, to download GPS base station files from Colo-i-Suva via e-mail. A user e.g. in Lautoka can announce the time he want to make a GPS survey. MSD will switch on the base station and will send the files via modem to SOPAC, next day. From there the user can download the files using e-mail service and avoids driving to Suva for base station file receiving.

Native Lands Trust Board (NLTB)
- The main activity undertaken by NLTB is the ALTA Task Force. Information is gathered from individual land owners to get into picture of the land lease situation. FLIS provides the cadastral data, NLTB carries out the field work.

Public Works Department (PWD)
- AusAID is prepared to fund equipment which includes software applications but when requested for 4 copies of MapInfo, advised that Arc/INFO would be better. SOPAC was re-

lected training areas. These training areas were selected according to their forest typing and site location distribution in the test site. While assuming a Gaussian distribution for the training areas on the selected bands, at +/- 2 standard deviation from the mean, we can expect 95% of picture elements to belong to that forest type. The spectral discrimination of the selected training areas cannot be distinctively visualised except with TM_3, TM_4 and TM_5 (Figure 1).

Bamboo growths can be differentiated clearly from the other forest types. Similarly, forest types represented by training areas unlogged named wp71ft1, logged named wp30ft3 and wp66ft1 can be differentiated from the remaining forest types.

A contingency matrix of the selected training areas showed a clear differentiation within some of these selected forest types. Certain overlap occurred with other forest types. This was understandable from the complexity of the rainforest composition (Table 1).

The table shows a clear discrimination of unlogged forest wp71ft1, logged forest wp66ft1, wp1ft1 and the bamboo growths. Under this situation forest types wp52ft3 and wp52ft1 display greater overlap with other forest type, thus requiring further investigation.

The training areas differentiation can be demonstrated by the signature ellipses separation and overlap (Figure 2).

Clear separation can be seen when selecting only certain forest types with

Table 1. *Error Matrix (%) of the Selected Training Areas.*

Data	wp71ft1*	wp90ft1	wp66ft1	wp1ft1	wp6ft8	wp53ft3	wp52ft1	wp30ft3	bambu_2	bambu_1	bambu_3
wp71ft1*	**8116**	030	000	000	184	1145	1469	000	000	000	000
wp90ft1	000	**7449**	638	000	000	871	020	745	000	000	000
wp66ft1	000	516	**9295**	000	000	000	000	378	000	000	000
wp1ft1	000	000	000	**9622**	184	000	041	000	000	000	000
wp6ft8	024	000	000	332	**6501**	068	571	000	000	000	000
wp53ft3	228	319	000	000	000	**4432**	1051	147	000	000	000
wp52ft1	1020	000	000	037	802	1977	**5255**	000	000	000	000
wp30ft3	000	957	067	000	000	108	000	**8720**	000	000	000
bambu_2	000	676	000	000	000	117	000	000	**9444**	526	542
bambu_1	000	015	000	000	000	000	000	000	185	**9474**	542
bambu_3	000	023	000	000	011	176	010	000	370	000	**8916**
Total	**1217,00**	**1317,00**	**893,00**	**1085,00**	**923,00**	**1022,00**	**980,00**	**953,00**	**54,00**	**57,00**	**203,00**

** = unlogged forest, bambu_1 = pure bamboo stand, bambu_2 & 3 = bamboo + forest trees.*
Detail descriptions of forest type 1 (ft1), (ft3), (ft8) have been currently undertaken.

quested to inform AusAID of the unsuitability of Arc/INFO.
- Digitising of water mains system is underway

PRESENTATIONS

Tevita Wara from NLTB presented the data transfer from NLTB to FLIS. At NLTB most data is still stored in Infomap. Now, a new program is written which translates all this data to InfoCad. This program is now able to translated graphical and annotation data.

Gerhard Zieroth from the Forum Secretariat presented the software "Environmental Manual for Power Development (EM). The EM is a computerised tool for the inclusion of environmental and cost data into the decision-making for energy projects, especially in Developing Countries.

The EM's key features are:
- A database which handles relevant information on energy projects, including references for data sources, and data quality indicators,
- A scenario module in which a variety of energy systems can be compared,
- An analysis module in which results from scenario runs can be determined,
- A graphic module to show results, and emission/cost trade-offs,
- An interactive online-help system which includes user help, user guide, and data and model documentation.

In Fiji, EM is supported by EU funded Pacific Regional Energy Programme (PREP). It is intended to establish a South Pacific user group which would interlink with the world wide user network. SPREP has suggested to use the model to built a regional data base and perform green house gas inventories.

Don Forbes from SOPAC presented a brief summary of the sea-level vulnerability and adaptation study in progress for Fiji Environment. This involves an analysis of flooding (inundation), overtopping, and shore erosion potential under various scenarios for higher sea-levels and storm surge associated with a global rise in sea level. A MapInfo application has been developed to compile information on shore type, backshore elevation, and vulnerability. This uses digitised shoreline and 5 m contour data from the 1:5000 topographic maps for Suva as a base and ground surveys along the Suva waterfront to provide data on sea-wall heights and backshore elevations. Differences in horizontal datum and limited verti-

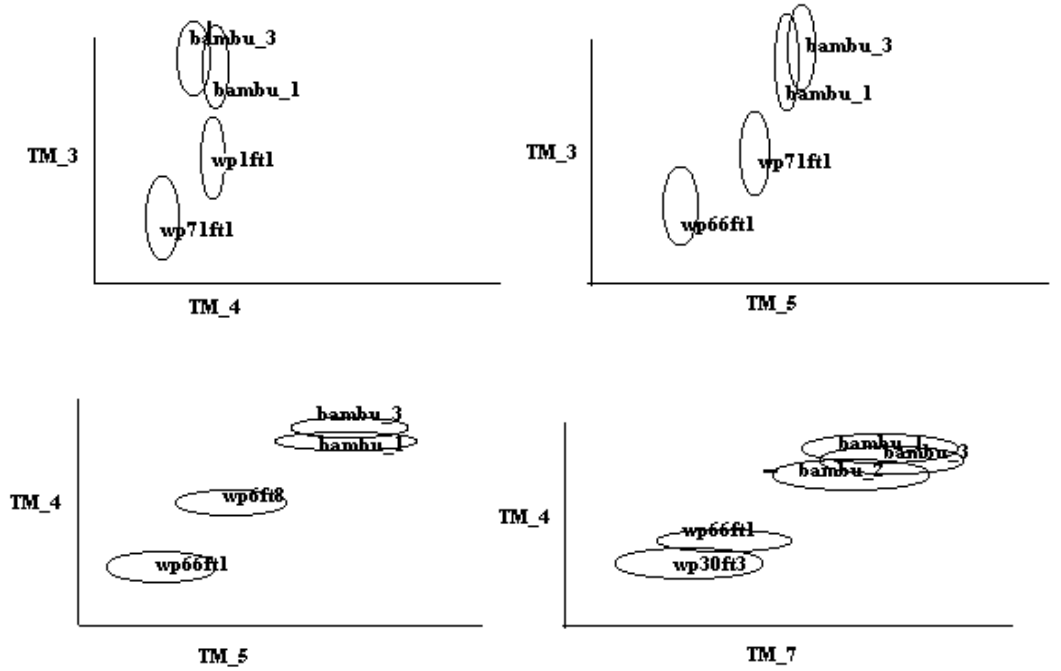


Figure 2. Signature ellipse with +/-2 standard deviation.

TM_3 versus TM_4. For example, unlogged forest wp71ft1 from the logged wp1ft1 and the bamboo growths. With TM_3 versus TM_5 clear separation was observed between wp71ft1, wp66ft1 and bamboo growths.

With TM_4 versus TM_5 the clear separation came only with wp66ft1, wp6ft8 and bamboo growths while TM_4 versus TM_7 showed greater signature overlaps

The results of the spectral differentiation from the selected TM bands showed sufficient grounds for spectral classification of rainforest types. TM_4 has a distinct spectral separation of all TM bands. However, this should be combined with a very good understanding of the local condition to ensure realistic forest typing.

Conclusion

The exercise based on the small test site of selectively logged and unlogged rainforest showed the possibility of TM data for further classification of rainforest forest typing under local conditions. For example, the distinction of bamboo growth from other forest tree species and the differentiation of the logged and unlogged forest. Therefore, it can be deduced that with the combination of infrared bands of TM data and good local knowledge further spectral separation of forest classes can be carried out. It is recommended that the integration of available SPOT and TM data should be carried out to provide improved separability over the currently available forest type map. This additional information is central to an understanding of the relationship between land cover and water run off which will assist in prevention of soil erosion, siltation, degradation of water quality, and resulting damage to the inshore fisheries resources.

Acknowledgements

My special thanks to the MSD field team of Samu, Epi and Taione together with Dr Wolf Forstreuter and Mr Rupeni Anise for their support as well as the valuable assistance from MSD staff.

cal control information have been among the problems encountered in this work.

DISCUSSION

Questions were asked about the file formats at NLTB and FLIS, because Infomap or InfoCad are not the software packages used by most of the other agencies. Tevita Wara explained again, that the translation software brings Infomap files to InfoCad file format. InfoCad provides the translation to the agreed file format in Fiji: DXF! The NLTB spatial data files are provided in DXF format to FLIS.

The Suva coast line mapping faced the problem of information available in different map projections and it was questioned if Fiji Map Grid (FMG) with spheroid WGS 72 is the best solution for Fiji. Forestry explained the problems they have had with different map projections and stated that FMG is the only solution. Mike Poidevin (worked in MSD) provided a translation program which is free available at MSD and translates co-ordinates from one system to the other. The discussion came to the recommendation to establish all spatial data bases in Fiji related to FMG and to the new map sheet coverage of the Lands Department.

The requirement for damage assessment of sea water rising is a digital terrain model (DTM) with one meter contour lines (better sub-meter). Such maps are not available in Suva and SOPAC is surveying with a total-station survey instrument. A discussion started about producing the DTM from aerial photographs at 1:5,000 or 1:10,000 scale. A GPS survey of sub-meter accuracy in height requires at least every 10 m a survey point. This will be an enormous workload which could be replaced by stereo mapping from large scale photography. The discussion will continue next meeting.

APRIL MEETING

Fiji Posts & Telecommunications Ltd, 2:30 pm, Tuesday, 2 April 1996.

WELCOME ADDRESS

The meeting was opened by Winston Thompson, Managing Director FPTL, who outlined the company's strategy and commitment to efficiency of operation through adoption of appropriate technologies that would provide benefits for customers through cost effective and innovative services.

An example of appropriate technology is the implementation of a GIS based solution to assist the company in planning and maintaining its growing communications network. The value of the Fiji GIS and Remote Sensing User group was highlighted and the continuation of the regular meetings was encouraged to provide an appropriate forum for exchange of information, transfer of technology and debate of policies which would ensure that the greatest benefits for the country would be achieved.

Department of Environment

- Regional training in GIS during 1 week UNEP funded workshop.
- SOPAC is continuing the implementation of the Environment Information System within the Department

■ *Les Allinson, SOPAC & Wolf Forstreuter, MSD-Forestry*

FIFTH REMOTE SENSING SEMINAR ON TROPICAL ECO-SYSTEM MANAGEMENT

Another Talk-fest? Another Shopping List?

There have been several meetings this year in preparation for this remote sensing seminar which will be held in Suva between the end of August and first or second week of September, 1996.

The seminar will be financed by NASDA through RESTEC and hosted by UN-ESCAP and participants at these planning meetings have expressed concerns about the relevance of the UN-ESCAP involvement, especially in view of quality of outputs of the previous seminar held in Suva in early 1995.

The planned seminar will consist of one part for presentation of papers and one part for "Hands on Training" with one day reserved for field visits. The "Hands on Training" will be carried out with satellite data, most likely JERS-1 recorded for the region. SOPAC, MRD and MSD-Forestry should name target areas for data recording. The "Hands on Training" will use public domain software.

A Japanese (RESTEC) team visited Fiji in March to discuss the seminar and it was apparent that the seminar was to be a vehicle for promotion of Japanese satellite data. Other relevant data, application and hardware vendors, in particular local vendors, could be excluded from displaying their products.

Pacific Island countries, many of whom have very small land areas spread over large tracts of ocean, are particularly susceptible to environmental degradation through exploitation of their natural resources without appropriate management. This degradation can easily be irreversible without tools to provide the necessary information to management. Remote sensing data and interpretation of that data is the most cost effective and readily available tool.

In this climate where solutions must be found through presenting the Pacific Islands with the widest range of available and affordable options, it is counter productive to attempt to create monopolies of data, applications or solutions.

Furthermore, there is a solid base of users in Pacific Island countries who have sufficient exposure to the technology of remote sensing who expect seminars to be vehicles for information and not promotion of product or endorsement of the hosting agency.

Summary of concerns

- *The purpose of a training with public domain software (remote sensing and GIS) was not clearly explained.*
- *It is unclear which countries will be included in the seminar.*
- *It is most likely that this seminar will be used as a promotion exercise for Japanese satellite data and other vendors will be excluded.*
- *It is unclear if the needs of the Pacific Islands will be addressed.*
- *Participants have not forgotten the outcome of the last seminar hosted by UN-ESCAP in Fiji where the preparation of a "shopping list" was one of the objectives. It was generally considered that preparing a "shopping list" without funding was particularly unproductive.*

■ *Bruce Davis, GIS Unit, University of the South Pacific*

GIS HUMAN RESOURCE DEVELOPMENT IN THE PACIFIC

NB: The following are excerpts from a longer paper in preparation concerning GIS human resource development. Criticisms and suggestions are welcomed

GIS Human Resource Development as a Paradigm

GIS without people has no value. Although it is high technology and has impressive capabilities, GIS nonetheless is still only a tool. It is an enabling technology—the major function is to empower humans to achieve goals that incorporate geographic (spatial) data. Therefore, the "people" component should receive primary consideration in planning, implementing, and operating GIS; emphasis should be on the human element and not the data or the software. However, all too often people are the neglected element in a GIS infrastructure. Such negligence can be harmful in Pacific GIS development and this paper presents the major considerations and issues in the region's HRD strategy.

The training, educational, and staff support aspects of GIS are part of the Human Resource Development (HRD) process. HRD is multidimensional, providing specific training (e.g., workshops) and long term education (diploma and degrees), as well as continuing maintenance and updating. Enhancement of skills and proficiency is an essential component of GIS HRD. This is especially valid in the developing world, where effective human resources are highly important but in relatively low supply.

Fiji Electricity Authority (FEA)
- See presentation

Fiji Land Information Support Centre (FLIS)
- See presentation

FPTL (Fiji Posts and Telecommunications Ltd)
- See presentation.

Management Services Division (MSD), Forestry Department
- 7 SPOT scenes have been geo-referenced to the new Lands Department mapsheets which have FMG projection. 24 sheets have now been completed.
- SPOT does not permit the sharing of data and requests for access to scenes have therefore been refused.
- 1:10,000 maps have been completed for Viti Levu hardwood plantations with the exceptions Colo-i-Suva and Nukurua. They are plotted on transparencies suitable for copying via Dyeline machine.
- Data capture for logging areas continues and more than 40 contour maps at a scale of 1:10,000 have been produced which is equivalent to an area of 25,000 ha.
- A special task was carried out at the request of the Prime Ministers office to provide a forest inventory of Laucala Island which the Government of Fiji is considering purchasing back. Such an inventory currently entails map production and data processing as well as the usual field work.

GIS in the PACIFIC

GIS has begun in the Pacific and is progressing very well in some parts, but rather slowly in others. It is well-established in Fiji, Guam, and New Caledonia, for example, but only a few organisations in other states possess some type of GIS, and even fewer make operational use of it. Technologic development is expensive and difficult, but the human component seems to be a, perhaps "the," weak link in most of the under-utilised countries, especially in terms of adequate training and dedicated personnel. There seems to be reluctance to allocate personnel to the proper training and then to assign them to the operation and development of modern technologies. GIS machinery may be in place in some countries, but the people are not.

Regional HRD Issues and Considerations

There is no comprehensive regional training strategy at present. SOPAC has a small programme to host several regionals for extended training and the University of the South Pacific (USP) is developing a certification and diploma programme; it currently offers only an introductory GIS course. For the most part, GIS training in the region has been ad-hoc, depending on various one-off programmes. They are almost always externally aided, usually with donor resources. Trainers are visitors who, despite their expertise and dedication, are unavailable for follow-up support. Workshops are limited to aid recipients and normally are not part of a regional scheme for GIS HRD. Regionalisation is needed.

The Pacific is maturing rapidly, however, and there are increasing demands for a programme that is more substantial and more regionally appropriate. The few steps mentioned above may be a rational start, but other issues must be considered. In brief, an effective regional GIS HRD strategy should

Native Lands Trust Board (NLTB)
- See presentation.

Public Works Department (PWD)
- See presentation.

South Pacific Applied Geoscience Commission (SOPAC)
- SOPAC will commence a survey this month to assess aggregate resources in the Majuro lagoon to assist the government in implementing its urban planning program The outputs from the survey are part of the larger Marshall Islands Coastal Zone management Program (MICZMP) for which SOPAC has been requested to provide technical assistance.
- In addition to the ongoing work under the MICZMP, SOPAC has been requested to provide proposals to implement the Marshall Islands Resource Information System which is a GIS based project. The outputs from the GIS are central to the success of the MICZMP.
- SOPAC will conduct a one week MapInfo training workshop for 20 participants from the government sectors in Fiji where FLIS will be the administrator. An innovative step will be the provision of a CD to each gov-

include at least the following qualities and concerns:

1. Dedicated programmes: without a designed strategy, speciality training and education becomes ad-hoc and ultimately a disservice. There must be recognition that the GIS user community has grown out of the initial exploration stage and it is now in need of structured advancement. The programmes at SOPAC and USP may not be enough.

   Dedicated HRD means that an approach cannot be a by-product of some other activity, lest it become subservient to other needs. The region cannot afford this type of subordinate development. A Pacific strategy is required
2. There are various levels of HRD needed: technician, manager, administrator, and for users in the many and diverse applications. Each has specific needs and limitations and each should be perceived as an integral part of HRD development. A system of brief informational workshops (e.g., half-day), training workshops (several days to a week), short courses (over a week), or even academic courses should be developed to accommodate these diverse needs.
3. A HRD programme must be local, national, and regional; various levels have specific demands. GIS can be a suitable "appropriate technology" but each organisation and nation must decide what "appropriate" actually means and what it involves. A well-developed HRD programme should be ready to support those decisions.
4. Continuing training, education, and support are required. HRD is both a maintenance and an evolutionary paradigm. Training (specific hardware, software, or applications) and education (broader concepts, integrated coursework) are not one-off processes; each is an on-going strategy that ensures the latest techniques and methodologies to the user community. Users need to keep up with advances, learn new "tricks," update software and hardware capabilities, improve current and new applications, refresh concepts and operations, and overall enhance their proficiency. Today's GIS specialist has one foot in the applications, one in computer science, and one in spatial methods—a three-legged dance is required for proper operations. HRD support is necessary on a continuing basis
5. Distance learning: The region is composed of some 15% of the Earth's surface but only a small amount of highly fragmented land, low and dispersed populations, too much concentrated development in the primate city, limited economic and technologic resources, and basically out of the world informational mainstream. A single centralised site such as Suva cannot provide adequate regional service. A system of outreach HRD is essential. Fortunately, there is some infrastructure from which to build a distance learning structure, e.g., USP's Extension Centre services, some distance learning advances under development at the USP GIS Unit, and the growing importance of the global Internet. There is increasing demand in many Pacific nations for GIS education and only a substantial outreach programme can answer the call. GIS HRD has to be accessible by the entire GIS/RS user community, not just the lucky few in Suva. Distance training is critical for regional development
6. The user community can not depend upon the first generation of GIS users indefinitely. A recent survey (March, 1995 GIS World) noted that more than two-thirds of GIS users in natural resources and environmental industries are self-taught, with over half receiving GIS training from short courses and 44% from vendor training; only 25% have

ernment department in addition to course notes provided to all participants. The CD will contain relevant datasets from Fiji provided by both SOPAC and FLIS as well as course material which will allow the departments to conduct their own in-house follow-up training. This will mean that participants will have relevant materials sufficient to become trainers within their own departments.

- MSD collects data from the GPS base station at Colo-i-Suva and will transfer the datasets to SOPAC via the remote mail system. SOPAC has installed a robot server connected to the Internet which allows surveyors with an Internet account to select datasets by mailing a message to the robot server which will return the results of the search by return mail. This will enable surveyors anywhere in Fiji to obtain data necessary for differential GPS accuracy provided that they have made arrangements with MSD and that they have access to a telephone circuit and are Internet subscribers.
- The Suva sea level vulnerability study being conducted for DOE is continuing and outputs are being prepared in MapInfo.
- Work on the Environmental Information System at DOE is progressing on schedule and the network is operational.
- SOPAC setup the computer based GIS systems at DOE to enable the UNEP funded workshop to be carried out.
- Promotional materials in the form of laminated A0 coloured maps were provided for distribution to the signatories of the South Pacific Nuclear Free Zone Treaty which was conducted at the Forum Secretariat in March. The maps which showed the accurate area of the Treaty where produced in MapInfo.

PRESENTATIONS

FLIS 1996 Projects - Kemueli Masikerei

The work program for 1996 focused on the stabilisation and consolidation of the core systems developed under the Stage 1 program. This should be completed by mid 1996 and include the projects: Valuation, State Land Register, Central Index, Titles Index, Town and Country Planing Application File, VKB, Native Land Commission Reports.

Other projects for 1996 include:

* Complete Initial Development of Computerised Cadastral Mapping System (CCMS).
* Develop Enumeration Area (EA) Mapping System.
* Complete Development of the Central Index.
* Establish Topo Database.
* Complete 1:50,000 Topo Maps.
* Develop State Land Register.
* Consolidate Crown Lease Administration System.
* Develop metric Native Land Commission Maps.
* Pilot Projects.
* Network Upgrade.
* Provision of Efficient and Reliable Remote Access Facility.

Training is an ongoing activity to enhance the role of the support centre and the announcement of Certificate and Diploma courses by USP has been welcomed.

FEA GIS and GPS - Prema Dehergoda

FEA is evaluating GPS and GPS at their Lautoka branch with the following aims:

graduate degrees in GIS. In the Pacific, we are still relying upon that "recycled" professional first generation to keep GIS moving, but the second generation should have more substantial formal training. The evolutionary states of the technology and applications demand it

7. GIS is establishing a new profession and a new set of technologic and applications concepts. It is not merely a computer and special software to make maps, but it should be thought as an integrated systems composed of hardware, software, data, organisation, and human resources. More important, GIS should be considered a methodology—an approach, a set of procedures and techniques. It is an efficient way to achieve old and new goals. Basically, GIS is a multidimensional and can be a highly valuable technology for the Pacific if developed correctly.

Conclusion

A successful GIS HRD programme will take time, will be dynamic and evolutionary, and ultimately it will provide the region with appropriate developments. GIS is only a tool, but a very important one that can help to achieve and sustain regional integrity and self-reliance. Certainly the human resource base is worth primary attention and national development strategies should ensure that essential balance.

* to map the power network using GPS;
* establish database;
* use GIS/GPS systems in planning and maintenance work.

What has been undertaken:

* MapInfo 4.0 purchased as the GIS with Trimble Pathfinder as GPS system;
* 16 chain maps with accuracy of several metres are being converted to sub-metre accuracy through GPS;
* Consumer database being created.

Problems encountered:

* GPS errors caused by Trimble software
* inability of the GPS systems to function close to transformers due to magnetic fields. The suggestion by Trimble that a series points be taken around the transformer but at some distance from the transformer was dismissed by FEA as totally unsatisfactory
* CCMS -> DXF -> MapInfo problems

NLTB GIG/LIS - Tevita Wara and Isoa Tuivai

The background of the system was detailed from the first ICL based system in 1975, through the replacement of Informap by Infocad, to the current Windows NT based system.

A highlight was the project resulting from the requirements of the ALTA Review Task Force.

The problem of confidentiality or restriction of data was addressed where it is possible that no data can be made available to assist the public and private sectors in determining native lease boundaries until after the ALTA review is released.

PWD Aerial Photography - Phil Wright and David Woods

There is a critical need to fully sewer the Suva peninsular to reduce pollution from seepage from the installed base of septic tanks and to increase the building area to plot ratio. The former is necessary for health and environment reasons while the latter will allow higher density buildings which will prevent the urban sprawl with its associated problems for cities with rapidly increasing populations. The objective of the design is to reduce costs by 50% through innovative technologies including the use of GIS/desktop mapping as well as securing cost effective aerial photographs.

It is necessary to obtain appropriate aerial photographs to create a Digital Terrain Model (DTM) the production of 1:500 topo maps with 0.5 metre contours to enable the rapid design of a cost effective sewer system. The maps will be line drawings including cadastral boundaries, contour lines,

■ *by Wolf Forstreuter, MSD-Forestry*

RE-WRITABLE MAGNETO OPTICAL DISKS,

A SOLUTION FOR TROPICAL COUNTRIES?

The Management Services Division (MSD), Forestry Department, is the Government institution where most digital map data has been stored in the last years. In the beginning, all data has been stored on 1.44 MB floppy disk. After creating an archive of more than 1000 disks the first problem appeared: fungus. The disk drive was unable to read some floppies because fungus was growing on the plastic due to high moisture of the environment. Time consuming digitising work was repeated to reinstall the necessary digital information.

MSD asked all computer companies in Fiji if they could supply an magneto optical disk drive solution in order to avoid the problem in future. South Sea Computing (SSC) made the best offer and sold a transportable drive able to read and write on magneto optical disks which have the same size of a 3.5" floppy, but allow to store 120 MB. MSD did not want to have disks with higher capacity because in case of physical damage of one disk the amount of 120 MB is already a high loss of data, in other words the risk is minimised if the storage capacity is relatively low.

Now, two years later, the first disk drive has very often reading errors and is hardly used anymore. The second drive can still read without problems, however, it has writing problems if data transfer of big files is applied. Even more problems create some disks, which only can be used after reformatting, which means total loss of stored data. The first investigation would look into a way to clean the reading and writing heads of the drive. The second investigation has to look for a possibility to clean the magneto optical disks, knowing that the fungus is sitting a dirt particle on the disk but not destroying the disk itself.

SSC tried to contact the supplier Pinnacle Micro Inc. in USA, but did not succeed, although being in the Silicon Valley. Then MSD contacted Pinnacle Micro directly, the answer was to blow compressed air through the drive.

■ *Josua Wakolo, MSD-Forestry*

FOREST CHANGE DETECTION IN NAUSORI AREA

- Notice About Results of First Field Trip -

The last newsletter reported on forest change detection using satellite data. It was stated that mangroves have been reduced in area by more than 10%. The field check showed that this figure must be updated to less than 10%. This is due to technical problems in separating the reflection of low density mangrove cover from water.

The field check verified that areas exist today which are covered with forest and which have been correctly mapped as non forest before. However, these areas are mostly dominated by the fast growing introduced species, African Tulip. First analysis shows the that this new forest cover substitutes up to 90% the loss of forest in medium density and scattered forest. If this result can be verified by further field visits and analysis it reflects the country-wide estimated change of the natural forest inventory.

It should be noted that African Tulip has poor mechanical properties and has no commercial value to the timber industry.

Another important result of the field check, the African Tulip dominated areas are visible with SPOT data.

streets where the ortho corrected photographs can be used as raster backdrop.

A major cost saving in the actual sewer system will be use of plastic pipes laid in shallow trenches as opposed to higher cost ceramic pipes laid in deeper trenches. The subsurface soapstone of Suva peninsular and surrounding areas presents high costs for conventional deeper sewer trenches.Another major cost saving can the of local expertise in aerial photography, creation of DTM, ortho-rectification of aerial photographs and use of GIS/desktop mapping.

This project is critical for the Suva peninsular as well as other Pacific Island urban centres experiencing rapid population increase as only through an effective and comprehensive sewer systems can health and environment standards be met while providing for higher density accommodation to reduce urban sprawl.

FPTL GIS Specifications - Sukendra Shandil

A GIS is required to assist in the planning, design, construction, utilisation and maintenance of the customer access network.The proposed system will be implemented nation wide using a network of workstations connected to a centralised GIS.

The specification is in four sections:
1. Defining of the GIS.
2. Defining Architecture of External Plant Reticulation System (EPRS).
3. System function requirements.
4. Consultancy.

The EPRS objective is to model data at the lowest level possible which is the individual cable pair. This model therefore is at the customer level. Information will be added to the cadastral base maps which includes all external plant: poles, pits, joint boxes, conduits, cables and all physical assets between the exchange and the customer.

The aim of the proposed GIS project is to provide interactive graphics to:
- Provide spatially contiguous database of FPTL network and allow management of both geographical and quantitative data within the GIS.
- Enable maintenance of the cable network through production of drawings.
- Prepare project costs from the GIS using estimating software modules.
- Provide asset accounting and inventory control functions.
- Prepare marketing forecasts through statistical modelling by linking demographic data with spatial data

DISCUSSION

The announcement by MSD of restrictions for sharing of SPOT data was addressed by NLTB who recommended that there be regular acquisition of satellite images of Fiji to assist in the monitoring of the Forestry resource and that avenues be explored to enable data to shared so that the acquisition costs could also be shared.

SOPAC reminded the meeting that it had implemented an MOU which committed regional organisations to share remote sensed data for the good of the region and stated that remote sensed data purchased by a government department in Fiji should be available to all other government departments without levy of further charges by the data provider. This sharing of data has been permitted by EOSAT for Landsat TM data

NLTB was requested to provide the mataqali boundaries and unregistered leases in digital format to assist surveyors in preparing reports for clients. NLTB suggested that this concern be tabled at FLIC forum and reminded the meeting that much data was restricted due to political sensitivities and may not be released until after the ALTA report is tabled and the issues resolved.

FLIS was requested to include the lease identifier in digital data to assist surveyors.

SATELLITE NEWS

EOSAT invests in **Portable Ground Stations** (PGS). One station was placed in Fairbanks (Alaska) to receive data from entire Alaska and portions of Canada and Russia. EOSAT expects delivery of two additional PGS. These stations can be set up by a three-person crew within 24 hours after arriving at site. Additional equipment such as cranes etc. is unnecessary (GIS World February 1996).

RADARSAT makes images available from February 1996. (GIS World February 1996).

Space Imaging plans to launch a satellite in late 1977 in co-ordination with Lockheed Martin, Raytheon's E-System Inc., Mitsubishi Corp., Eastman Kodak Co. and other partners. This satellite will provide 1 metre panchromatic and 4-metre

multispectral imagery (GIS World January 1996).

SPOT Image increases the prices for satellite images. A scene with 1A or 1B processing level costs:

SPOT Pan:	60 x 60 Km	$AUS 3,800
SPOT XS:	60 x 60 Km	$AUS 3,100

The special acquisition increases from $AUS 250 to $AUS 300 for white service[1]. A physical image along with the digital product costs $AUS 750 for SPOT Pan and multispectral data.

Two scenes from the same area usable for a stereo image for processing level 1A or 1B cost:

SPOT Pan:	$AUS 5,500
SPOT XS:	$AUS 4,800

(information from SPOT Image Australia).

NASDA (National Space Development Agency of Japan) signed a letter of intent with EOSAT, to receive, process and archive data acquired from the Indian Remote Sensing satellite program. EOSAT is in discussion with other members of the global network of 15 ground stations to secure similar agreements for receiving data from the Indian satellites. EOSAT is the exclusive distributor of IRS data outside India. The addition of India's IRS satellites to the constellation already collecting Earth observation data means increased earth coverage and the acquisition of more cloud-free data. (GIS World March 1996).

IRS-1C data is now available from EOSAT. The satellite has two interesting sensors on board, LISS-3 and WiFS (Wide Field Sensor). EOSAT advised the newsletter that the onboard tape facilities allow recording scenes from the South Pacific. The repeat coverage is 24 days and the repeat coverage with off-nadir viewing angle is 5 days. LISS-3 covers the green, red and the near infrared portion with a spatial resolution of 23.5 m. An additional infrared band is available with a spatial resolution of 70 m. Panchromatic data is available with a spatial resolution of 5.8 m!

WiFS data has a spatial resolution of 189 m and only records the red and the near infrared band, but the swath width covers 774 Km.

LISS-3	Super Scene	141 x 141 Km	$US 2970
LISS-3	Scene	70.5 x 70.5 Km	$US 2070
Pan Camera	Pan Scene	70 x 70 Km	$US 2500
Pan Camera	Pan Junior	23 x 23 Km	$US 900

A special acquisition does not cost extra!

(information from EOSAT).

[1] SPOT image continue trying to get a scene with less than 10 % cloud cover, if there is not comparable scene in the archive.

■ *Edmund Chang*

GIS PILOT PROJECT FOR LOVU SECTOR

We have completed the GIS pilot project for the Sugar Commission of Fiji (SCOF), which involved use of the MapInfo GIS software and the Trimble GPS system. The sugar cane growing sector of Lovu was chosen and is located near Lautoka. It is bounded by the Namoli creek to the west and Vitogo river to the east. We picked Lovu since it was an ideal sector that was located next to an urban location and most of it's farms were under native lease which would be affected by the Agricultural Landlord and Tenants Act (ALTA). Urban en-

■ *Prakash Narayan, ORSTOM-Latical, BP A5 Nouméa, New Caledonia*

SOME INTERNET SITES FOR REMOTE SENSING

Some of the Remote Sensing / Geography Information Systems sites found on the Internet using Netscape.

- http://www.ccrs.nrcan.gc.ca/ccrs/homepgf.pg?f
- http://www.cct.rncan.gc.ca/gcnet
- http://www.ccrs.nrcan.gc.ca/ccrs/radersat/rsatf.html
- http://www.radersat.espace.gc.ca/
- http://www.vtt.fi/aut/ava/rs/virtual/
- http://www.geo.ulg.ac.be/
- http://www.usherb.ca/CENTRES/CARTEL/Cartel.html
- http://www.belspo.be/telsat/
- http://www.ggrweb.com/
- http://www.ngs.noaa.gov
- http://ewse.ceo.org
- http://www.city.cict.fr8001/
- http://www.wcmc.org.uk/dynamic/desert/index.html
- http://ewse.jrc.it
- http://www.spotimage.fr
- http://www.crisp.nus.sg

It is personally not possible to go through all of these RS/GIS sites available on the Internet because it will take considerable time. Therefore, comments are most welcome to find the better sites and in the process, new sites can be added to update the list regularly.

Compiled from:
Le Journal du Réasau Télédétection de l'AUPELF-UREF .
ASPRS/ACSM Annual Convention and Exhibition , Preliminary Program.

croachment and productivity are also some of the issues that affect Lovu.

When we embarked on the GIS pilot project of the Lovu sector, we had to derive our source of information from both digital and hard copy (paper based maps and database sheets) sources. The digital information included cadastral data provided by FLIS, digitised database (in Microsoft Excel format) of Lovu farms on disk provided by FSC computing centre, Native leases boundaries provided by NLTB and GPS captured field data of unsurveyed farm boundaries. Digital coordinates from very recent approved surveys of unregistered leases converted to graphics were also added to update FLIS and NLTB imported data. Hence the pilot project is a visible value added GIS system for FSC use.

Hard copy information included sector maps, aerial photographs, Lands Dept cadastral sheets and recent uncharted survey plans. We used these to audit our computerised map and database entry as well as locating parcels.

We then manually polygonised our map data in MapInfo and entered the title, survey plan numbers, NLTB File and Farm Registration numbers as the interchangeable primary key for each parcel. In this project we needed the vital link between survey plan and lease title to complement the FSC sector map and data. Since this is not yet available from FLIS or the Office of the Registrar of Titles, we had to rely on NLTB to provide the important connection to the NLTB file reference and farm registration number. We also had to carry out rigorous auditing since the above involve a considerable amount of manual entry from several sources.

We used Farm Registration Number as the unique identifier so that we could automatically update the columns with an imported database (originally in Microsoft Excel format) in MapInfo. Following that we entered text data into the MapInfo database for Lovu by manual and automatic means. Given the information by FSC Computing Centre we were able to produce the following colour coded thematic map layers (with respective legends):

■ *Bill Thoen, GIS World, December 1995*

MAILING LISTS CREATE VIRTUAL COMMUNITIES

Bill Thoen is owner/operator of GISnet BBA, 1401 Walnut St., Suite C, Boulder, CO 80302. He is the author of On-line Resources for Earth Scientists, available via FTP to ftp.csn.net in the COGS directory as the file ores.txt. He can be reached via E-mail on GISnet BBS at 303-447-0927, or on the Internet at bthoen@gignet.com.

This month, I discuss mailing lists: how they work, where to find them and how to use them, along with providing a list of some good ones. If you have access to the Internet, you can join in right now, because E-mail is all you need to participate.

A mailing list essentially is an on-line discussion group dedicated to a particular topic or interest. When you send an E-mail message to a mailing list, a copy of the message is automatically sent to each subscriber's E-mail box. That way, any number of people all over the world can take part in a discussion as though they were in the same room.

There are usually two E-mail addresses associated with mailing lists. The first is known as the "server" address. The server address usually is managed by a "robot" program that accepts your commands and acts on them right away. Thus, you can put your name on a list (or get off a list) and get list information whenever you wish

Automatic list servers however, are limited in what they can understand, and they refuse to do anything unless you issue the right command. Spelling and syntax count, but not typecase. In other words, you can send a server either the command "help" or "HELP" and still get the expected answer typing insults in uppercase or sending grovelling messages in lowercase doesn't faze servers. But they patiently send you the standard help message if you don't send proper commands.

The second address is the actual "list" address. That's where you send all messages intended for other subscribers on the list. This is not the address to send commands to, because here you're talking to humans. Of course, you can ask people publicly what the server address is if you've forgotten, but say it in English (or French, German, etc., depending on the list's distribution regional if you want a response.

There are several common programs that manage mailing lists. They have names like listserv, majordomo, mailproc, mailbase, listproc and so on. To use one, you have to know the commands each server understands. Virtually all of them accept "subscribe" or "unsubscribe" commands, and all can respond to the "help" command, but there are important differences between them, too. If you know a server address, but know nothing else about how to use it, send it a one-word message, "help", and nothing else, in the message body. That will cause any mailing list server software to send you a list of instructions about how to control its particular server.

Servers can do more than just manage your E-mail address for a mailing list. Abilities vary with each server software program and its owner's attitudes about security. But beyond letting you on or off a list, most are capable of providing you with other subscribers to the list, or allow you to receive files relevant to your list (such as archives of past message). Some even can perform keyword searches on past messages, or send you a "digested" version of each day's mail.

How To Find A Mailing List

The best way to find a mailing list on a particular subject is to post a message over an existing list and see what people can tell you. People often read more than one related list, and they usually can give you a handful of choices in their areas of interest.

Some new mailing lists are announced on related mailing lists and Usenet newsgroups. In particular, look in the Usenet newsgroups news.lists,news.answers and news.announce.newusers for more information. Stephanie da Silva's list of more than 1,374 mailing lists can be found periodically in the Usenet newsgroup news.announce.newusers, or on the anonymous File Transfer Protocol site at rtfm.mit.edu in the directory /pub/usenet-by-group/news.answers/mail /mailing-lists.

All files on the rtfm server also can be collected via E-mail. Send a message to mail-server@rtfm.mit.edu with the word "help" in the message body for more details

How To Subscribe To Mailing List

If you want to subscribe to a list, first send a message to the server address, leaving the subject field blank (or just key in a period if your mailer software insists on something being there. Next, place a "subscribe" command in the message body followed on the same line by the name of the list

- Harvesting gang distribution - light green would represent Gang Number 1 which is also named Field four Gang, dark blue would be Gang Number 11 etc.
- Transportation type - where green represents farms that transport cane to the mills via lorry and pink would indicate farms that transport cane to mills by railway.

you wish to join. For example, if your name was Gerhardus Mercator and you wanted to join the general GIS discussion list, GIS-L, you'd send a message to listserve@idi.net and put in the message body:

subscribe GIS-L Gerhardus Mercator

But if you wanted to join the MapInfo discussion list, which is run by a majordomo listserver, you'd send your message to majorodomo@csn.net, leaving off your name (majordomo can accept an Email address, but not a name) like so:

subscribe MAPINFO-L

When you successfully subscribe to a mailing list, the first message you'll receive is from the server confirming your subscription. The message also provides additional information about the list, related resources, contacts, rules and, most importantly, how to get off the list. Many people forget how to get off a list, and end up annoying everyone else with their pleading, cursing and carrying on (typically via messages sent to the wrong address). I can't emphasise enough the importance to use it one day!

- Ethnic group - where red represents Indian tenancy and green for Fijian tenancy
- Lease type - yellow represents native leases, pink for IT (Instrument of Tenancy), violet for Vaka Vanua leases and light green for crown leases.
- Land utilisation - this is a ranges map indicating farms that are utilised under contract as a percentage of lease. It ranges from orange (above 90%) to dark green (less than 50%).

We were also able to get Native Land Commission (NLC) boundaries which could be laid over the thematic map layers, such as by Lease type or Ethnic group distribution. We managed to obtain the NLC data (both graphic and text) from the NLTB, who exported their data via InfoCAD to DXF format. We then imported their DXF file into MapInfo and got their text data by importing it through a Microsoft Excel file. The text data contained information such as Mataqali name, land owning unit and Toka Toka number.

From the above thematic overlays we were able to present to SCOF many practical and probing question arising from ALTA and the evident costs to both landlord and tenants.

We hope to obtain further information relating to number of families per Mataqali (land owning unit), population over 18 years, unemployment population and educational level in the Mataqalis. In the same way we hope to get similar informa-

GIS-Oriented Mailing Lists Abound

The following are just a few of the active mailing lists that may interest the GIS community. A more complete list is available from the GISnet BBS Online Resources for Earth Scientists World Wide Web page at http://www.gisnet.com/gis/ores/mail.html.

AGIS-L—Atlas GIS Topics
Server: majordomo@ciesin. org
List: AGIS-L@ciesin.org

COASTGIS—Coastal GIS Issues
Server: listserv@irlearn.ucd.ie
List: COASTGISi@irlearn.bitnet

ERDAS—ERDAS Topics
Send the message "subscribe chest-image <insert your name>" in the body of the text.
Server: mailbase@mailbase.ac.uk

ESRI-L—ARC/INFo, Arcview Topics
Server: esri-l-request@esri.com
List: ESRI-L@esri.com

GENASYS-L—Genasys GenaMap GIS Topics
Server: majordomo@genasys.com
List: GENASYS-L@genasys.com

GEOWTB—On-line GIS Resources Discussion
Server: majordomo@census.gov
List: GEOWEB@census.gov

GIS-L—General Geographic Information System Topics
Server: listserver@idi.net or listserver@urisa.org
List: GIS-L@idi.net or GIS-L@URISA.org

GIS-JOBS—GIS Jobs in UK
Server: mailbase@nailbase.ac.uk
List: GIS-JOBS@mailbase.ac.uk

GISBUS-L—GIS in Business
Server: listserv@ecuvm1.bitnet
List: GISBUS-L@ecuvm1.bitnet

GRASS—Users Support List
Server: grassu-request@moon.cecer.army.mil
List: grassu-Lisst@moon.cecer.army.mil

IDRISI-L—IDRISI Topics
Server: mailserv@toe. towson. edu
List: IDRISI-L@toe.towson.edu

LMAGRS-L—Image Processing and Remote Sensing
Server: listserv@csearn.bitnet
List: IMAGRS-L@earn.cvut.cz

MAPHIST—Historical Maps Topics
Server: listserv@harvarda.harvard.edu
List: MAPHISI@hurvarda.harvard.edu

MAPLNFO-L—Mapinfo Topics
Server: majordomo@csn.org
List: MAPINFO-L@csn.org

MAPS-L—Map and Air Photo Systems Forum
Server: listserv@uga.cc.uga.edu
List: MAPS-L@uga.cc.uga.edu

tion for the tenants whose farms are apportioned between the different land owning Mataqali units. In this way one can analyse and compare the social and economic situation of both tenants and landowners.

GPS was used to capture boundaries of unregistered and uncharted leases in the Lovu sector which were particularly concentrated towards the Namoli creek area. In the field we used both vehicle and foot to locate and capture sugar cane farm boundaries. Where we could not identify boundaries from sector maps and air photos we consulted FSC farm advisors or Harvesting gang sirdars (leaders). We made two separate field trips to Lovu sector and managed to capture most of the unregistered leases by GPS.

For differential correction of our field data we relied on the Forestry Department in Colo-i-Suva to access their base station. We used the post-process method of correcting our data by collecting base station files from Forestry after returning from the west. The GPS software used in the process was GeoPC (Trimble). We then converted the corrected data into a GIS compatible file which was DXF since MapInfo could accept it.

We then imported the DXF file into MapInfo and were able to see the boundaries of the unregistered leases matched against the registered and polygonised parcels that we had previously captured. Using a database of x and y coordinates we were also able to further locate other unregistered leases by geocoding them on the map. These coordinates were obtained by calculating x and y coordinate readings from a map sheet of ground surveys of uncharted sector farms. Thus we were able to trace the unregistered boundaries of both the GPS data and geocoded coordinates on the map.

In the final stages after having entered text information and deriving thematic maps in MapInfo, we did a full audit of the map by checking the Harvesting Gang database sheet of the Lovu sector (supplied by FSC computing centre). We ensured that the names in the MapInfo database matched the gang number and names in the database sheet. We also used the plan number from sector map sheets to locate the remaining missing parcels. Time and time again we consulted the Harvesting gang data sheets to audit any changes made to the map.

Cost of GIS

The current constraints in the importing of CCMS data from FLIS is a significant cost to the set up of a functional GIS system. Listed are some of the limitations to overcome that would materially minimise costs and delays.

- **Unpolygonised graphic data**. Until FLIS can provide this automatically with graphic data this would be a significant cost involving manual polygonising.
- **Lost text data through importation**. The next option here is to manually copy data from Lands Department cadastral sheet which also require further auditing - a time consuming exercise that is open to mistakes.
- **Unique Text Data** The use of survey plan as key identifier instead of the commonly used title number could be a great burden to other GIS users who will need to rely on a secondary source of data acquisition e.g. Registrar of Titles. Survey plan numbers are only useful to technical people like surveyors and perhaps land administrators.
- **Unavailability of other key links in cadastral data from FLIS central index.** When this is automatically accessible for the first time from FLIS importing errors will be minimised. Currently this has to be separately acquired from the Registrar of Titles.

Accuracy Requirements

The accuracy of digitised vector data from FLIS and NLTB is more than adequate for our purpose in the project. A check overlay of both data revealed no critical difference for our use allowing us to conveniently merge our GPS data into the system. We also discovered that MapInfo graphics is capable of

■ *Leslie Allinson, SOPAC*

BEYOND COMPACT DISK

The ubiquitous CD which we depend on for audio, software and data is rapidly showing its age with the current 630 MB limit. New releases of software require multiple CDs and some of the latest computer games which have extensive graphics are being supplied on 6 CD sets.

When 250 MB hard drives were the standard in 1994, the 630 MB CD was a good balance. However, with 1 GB hard drives as the recommended entry level a larger format CD is required and a larger physical size is not the answer. The current 120 mm diameter CD fits into drives which fit drive bays which once held drives for 5¼" floppy disks (remember those?) and there is such a large installed base of those CD drives that manufacturers will retain the current form factor in the next generation of CDs.

But it is not audio, software and data which is driving the search for higher capacity CDs, it is video. The days of the VHS tape were numbered when videos were released on optical disks called "laser disks" but the unacceptably large form factor and inadequate storage of the laser disks has led researchers to find ways to pack more data onto the CD.

The new standard called Digital Video Disc (DVD) has evolved after agreement by two consortiums who were developing separate standards and who no doubt remember the confusion that existed when consumers were faced with the incompatible Betamax and VHS standards for video tapes. The two consortiums are Matsushita, Time Warner and Toshiba who proposed Super Density (SD) and Philips and Sony who favoured Multimedia CD-ROM (MMCD). The SD format did not provide for backward compatibility with today's CD and fortunately for users, the new agreed format will allow existing CDs to be read.

There are four formats proposed in the new standard:

1. single side single layer - 4.7 GB
2. single side dual layer - 9.4 GB
3. double side with dual layer on one side and single layer on the other - 14.1 GB
4. double side with dual layers on both sides - 18.8 GB

Dual layer is not a new technology and consists to two translucent layers with the ability of the laser head to focus on either layer. However, it is anticipated that the single side single layer will initially dominate the mar-

ket as there is sufficient capacity (133 minutes of MPEG-2 video) to store most movies.

DVD will be therefore be an immense benefit for the GIS and Remote Sensing industry with the ability to distribute high resolution three dimensional data for animated GIS on a single medium as well as distributing world-wide data sets.

When are we likely to see DVD? Possibly late 1996 and industry analysts are predicting that set-top boxes will retail for around US$ 500 which gives an indication of the cost of a DVD drive and interface for players. The first DVD recorders (DVDR?) will follow the players and it is expected that pricing will be similar to recordable CDs which emerged in 1994 with $10K plus price tags but have since fallen to under $1K.

being adjusted to a higher accuracy in whole or in part particularly if needed on a larger scale. Hence existing digitised graphic data can be superseded (of course at an additional cost) by the input of digital coordinates from surveys and 'snapped on' where necessary.

On the credit side we always have the valuable assistance from FLIS, NLTB and Forestry Department and the ever helpful service of SOPAC.

When the sector was fully completed we demonstrated the final result to SCOF members in their general meeting (20-Feb-96) as well as the GIS user Forum on the 13-Feb-96 at the USP. To date we are still waiting on SCOF's response to our pilot project.

Training FEA staff to use MapInfo

The Fiji Electricity Authority (FEA) requested a tender for the set-up of a GIS and GPS system for their Planning department. They were particularly interested in using MapInfo and Trimble GPS system as well as a base station. Kevin McConell (Lukemine Enterprises) organised for FEA staff to be trained in using MapInfo 4.0 and the GPS software Pfinder. In the process we were selected to be their trainers in the MapInfo software.

We conducted the training for 4 days from the 27-Feb-96 to 1-Mar-96. The training centre was conducted at the FEA headquarters at Navutu in Lautoka. There were four participants all of whom were from the Planning department. Trainees were taught the basics of GIS, how to analyse, modify, improve and output map information using MapInfo. They also learned about how to link GPS field captured data with a GIS system like MapInfo

For an organisation to operate and maintain a fully functional GIS system would certainly require a great deal of effort from the users. Training would be an important part for any organisation that intends to implement a GIS system. Having conducted the first training for FEA, we find that staff need to have a hands on experience in using the GIS software as well as confidence in applying what they know (from training) to solve a practical problem. Training requires a number of criteria and they include.

- proper training location where trainees cannot be interrupted by phone calls or work commitments.
- prior knowledge of Windows and DOS operating systems would be advantageous for software trainees
- prior knowledge of elementary surveying, appreciation of maps and co-ordinate system would be most helpful but not compulsory
- enough PC's for each trainee to get individual hands on experience
- trainees should be able to work on a practical GIS example after the training session. This would include using sample data from the organisation.

As mentioned earlier, we appreciate the help given by members of the GIS user forum and owe them a lot for our achievement. It is hoped that our experience in this project would benefit readers by giving them an idea of what is involved in implementing a GIS system.

■ *by Wolf Forstreuter, MSD-Forestry*

Satellite Image Data Requirements for South Pacific Island Countries

INTRODUCTION

South Pacific Island Countries have the unique problem of frequent cloud cover and remote and isolated location. This makes aerial photographs expensive and the demand for satellite images has often been voiced. This article describes the available data, the data user and the user requirements. Many potential users do not know which data can be purchased besides SPOT images and it may be useful to discuss data requirements and data costs before planning a mapping project. The satellites RADARSAT, ERS-2 and JERS-1 have radar sensors and tape facilities to store data of South Pacific Island Countries. These systems are not covered in this article, because radar data employment of radar data for map update at 1:100,000 and larger is still in the investigation stage.

DATA REQUIREMENTS

Space borne data capture and marketing is a commercial business and follows the rule of private market economies. High demand for a particular data type creates the most satellites providing such data and the lowest price such as multispectral data for mapping at 1:50,000 scale. The more specific data for less frequent map updating e.g. for topographic features such as roads or contour lines is more expensive.

Main User

The main application of remote sensing data in South Pacific Island Countries is the forestry sector, due to its high demand of remote sensing information for forest monitoring. The pressure on the forest resource requires regular mapping. The next important use of satellite data is for coastal mapping. Another potential application is the update of topographical maps, normally handled by government lands de-

partments. Crop evaluation, forecast of agricultural areas or disaster mapping will play a role in the future.

Requirement of Space Borne Remote Sensing Data Type

34 % of the world's land area is still without map cover at 1:50,000 scale, most of this area is part of developing countries. However, this does not apply to the South Pacific Island Countries. Here map updating is of major importance, and the data application defines the requirements of remote sensing data type. For forest monitoring (regular map update every three to five years) a mapping scale of 1:50,000 is sufficient. This also applies for land use mapping or coastal zone mapping. Such mapping requires a spatial resolution of 15 to 30 m, a bigger picture element size cannot be used for map printing and a smaller size creates problems in the data handling. Also, important is the radiometric content, bands of the infrared portion allows additional forest stratification (see Table 1). The next bigger scale for forest mapping is 1:10,000 (selected areas). For such a scale space borne data has not been tested on an operational basis in Fiji. Airborne data is used. Topographical mapping requires the recording of linear features which can be interpreted from panchromatic (black and white) image data. As previously noted, the topographic mapping is complete for most South Pacific Countries and some topographic information such as contour information will not change within a period of hundred years. Therefore, the requirement for regular updates of space borne remote sensing data for the establishment of a digital terrain model such as SPOT Pan or KFA-1000 is not mentioned further.

Local Map Projection Requirements

The agreed common map projection in Fiji is the Fiji Map Grid (FMG), which has corresponding local projections in other South Pacific Island Countries. Such country related map projection is essential in the South Pacific because due to the proximity of many countries to the 180°, most world wide used map projections have problems. For example, UTM would divide Fiji in two totally different UTM zones! However, a local map projection requires a geometric correction of the purchased data in the country. Such an activity defines ground control points (GCPs). GCPs are points with known FMG coordinates which are visible in the data set. If there are no points visible with known coordinates, the coordinates of visible points have to be determined by Global Positioning System (GPS) survey in the field. Using the GCPs a computer program corrects the digital data. such a geometric correction requires:

- an image analysis system
- high resolution monitor
- 600 Mb hard disk (for a Landsat TM scene, 30 m resolution)
- fast CPU

The requirements increase with the ground resolution of the data. If the geometric correction is carried out by the satellite data selling agencies, it is difficult to include new GCPs, and normally only world standard projections can be purchased. Further, if a user acquires geometrically corrected data some important image enhancement procedures cannot be carried out such as destriping.

The necessity and the related difficulties of geometric correction have to be taken into account if the need for high resolution data is specified.

Accuracy Required

The accuracy of mapping is correlated with the mapping scale. The US standards require:

accuracy	mapping scale
± 5m	1:25,000
± 10m	1:50,000
± 20m	1:100,000

For map maintenance and updating of vegetation cover (including land use mapping, coastal mapping etc.) in the South Pacific Island Countries, the following accuracy should be appropriate. The physical conditions such as shrinkage due to moisture during digitising or inaccuracy due to transformation of map projection does not allow the process to be more precise than half a millimetre.

accuracy	mapping scale
± 2.5 m	1:10,000
± 15 m	1:25,000
± 40 m	1:50,000
± 80 m	1:100,000

AVAILABLE SATELLITE DATA

There is more space-borne data available for the South Pacific than most potential users know. Digital data is recorded by scanner or push broom scanner such as Landsat TM and MSS, SPOT, JERS-1, MOMS-02 or IRS-1C while KVR-1000, KFA-1000, TK-350 or MKF-6 record on photographic film. Except MOMS-02 which will be brought to space during this year, all other data is theoretically available. In August 1996 a civilian satellite will be launched by a US company providing 3m resolution data which will be explained in a further article.

SPOT

In the French speaking parts of the South Pacific, SPOT is the best known satellite and probably has the widest data application. There are two SPOT satellites in orbit which provide two types of data each: a) panchromatic (black and white) digital images with 10 m ground resolution which can be used for 1:25,000 infrastructure mapping and b) multispectral data of 20 m ground resolution which is useful for forestry and land use mapping at 1:50,000 scale. The satellites have an onboard tape and are able to store recorded data until they fly over France where they download the data to a ground station.

Type of Data	Coverage	Price	Acquisition
SPOT XS	60 x 60 Km	$US 2,411	$US 233
SPOT Pan	60 x 60 Km	$US 2,956	$US 233

Landsat

Until last year there were two functioning satellites in orbit, Landsat 4 and Landsat 5. Both satellites have had two sen-

sors on board a) a Thematic Mapper (TM) and b) a Multi Spectral Scanner (MSS). The TM provides data with a ground resolution of 30 m which can be used for 1:50,000 mapping with high radiometric resolution providing good vegetation stratification. The MSS sensor provides data with 80 m ground resolution and can be used for 1:100,000 mapping. The sensor covers more from the near infrared than SPOT which enhances the capability of vegetation stratification. Landsat 4 and Landsat 5 have no onboard tape facilities and cannot store recorded data. Landsat 4 has the potential to download data via relay satellite. This allowed MSD-Forestry to map Fiji's natural forests with TM data. However, the TM sensor of Landsat 4 stopped operating and the MSS data are not captured anymore. Without a portable ground station, recent TM data cannot be purchased for the South Pacific.

Type of Data	Coverage	Price
Landsat MSS*	175 x 180 Km	$US 1,000
Landsat TM	175 x 180 Km	$US 4,400

* recent MSS data is not available anymore.

IRS-1C

IRS-1C data is available for the South Pacific, now (see Satellite News in this newsletter). The satellite carries three sensors: LISS-III, with 20m resolution, a panchromatic camera with a sub 10m resolution and a Wide Field Sensor (WiFS), with approximately 188 m resolution. This satellite will have a on board data recording facility. This will allows to order data from South Pacific Island Countries. EOSAT is marketing the data for IRS and the data cost is:

Type of Data	Internal Name	Coverage	Price
LISS-3	Super Scene	141 x 141 Km	$US 2,970
LISS-3	Scene	70.5 x 70.5 Km	$US 2,070
Pan Camera	Pan Scene	70 x 70 Km	$US 2,500
Pan Camera	Pan Junior	23 x 23 Km	$US 900

JERS-1

JERS-1 was launched on 11 February 1992. The satellite has a sun synchronous orbit with an inclination of 98° similar to Landsat (over-flight approx. 10:30 - 11:00). It has a Synthetic Aperture Radar (SAR) and Optical Sensors (OPS). The OPS has 8 bands. However, the infrared-bands gave up to work only achieved data are available. The ground resolution is 18 m x 24 m. Band 4 has the same characteristic as band 3 but the sensor is looking forward. The combination of band 3 and 4 creates a stereo image pair. Digital images can be purchased from RESTEC or EOSAT as a sales representative of RESTEC. A scene covers 70 x 70 KM and costs $US 1,250.

KVR-1000

KVR-1000 images can be purchased through EOSAT. EOSAT, PADCO an international Consulting company from USA and Kiberso a Russian geographic information system company signed an agreement to process and distribute Russian space-borne photography world wide. Kiberso situated in Moscow has access to archives of the Russian Military Cartographic Department, where KVR-1000 images are stored. This panchromatic image data has a spatial resolution of less than 2 m and allows mapping of infrastructure elements at a scale of 1:10,000. However, the sensor is a photographic camera exposing film-material. The image data is available as digital data, but it is scanned from this film keeping the central projection of a photographic camera. The camera was based onboard the Russian Kosmos satellites. Each mission generally lasts 45 days which enables the camera to photograph nearly 50 % of the Earth's land surface along its ground track. The images cover approximately 34 x 57 km on the ground depending on the missions flight requirements (normal altitude is 220 Km). There are images available for Fiji taken in 1991 and 1992 which show cloud free areas from eastern Viti Levu. For further information (see "Available High Resolution Images for Fiji" in newsletter 9405). Radiometrically corrected digital data costs $US 3,500.

TK-350

The TK-350 usually flys together with the FVR-1000 camera onboard the Kosmos satellites. The resolution of 5 to 10 m is less than the one of the KVR-1000 camera. The reason for this second panchromatic camera is the potential of stereo

■ *Michel Larue, Mapping Geologist, SOPAC, michel@sopac.org.fj*

The evolution of a desktop mapping utility into a full-flavoured GIS

MapInfo has been adopted in the Pacific region by many organisations and many government and private companies. It has thus become a *de facto* regional standard for desktop mapping and vector GIS. This success is based on its good compromise between power and ease of use.

Nevertheless, many users have found that its relative simplicity is at the cost of essential tools, missing in the core product. This limitation can be overcome by the existence of a sibling product, MapBasic, which not only automates repetitive tasks but is a full development language.

It sounds that we are back in the old ages when one had to write pages and pages of code to have the work done. Is this so? No for two reasons:

1. The language is much more powerful than the old FORTRAN or C languages. The built-in functions are already GIS and database analysis oriented, the bricks to build applications are bigger and bigger, and as a result, the code shorter and shorter.
2. The problem you may encounter as some others already have. Utilities have already been developed, Where are they? How can I lay my hands on them. How do they work? This is where SOPAC can provide a unique and essential link so far missing.

MapInfo Corporation already distributes some of these tools with their flag product. For instance to make grids, or scale-

bars. The code is also distributed as part of MapBasic package as tools and as programming examples for future developments. As a MapInfo power-user SOPAC also developed utilities. Finally some are available on INTERNET. All of them have been carefully checked, often standardised, documented and packed. It constitutes more of an open add-on than a closed stand-alone application.

For example, you have the points that limit a field that you obtained from a GPS and you want to import them into you favourite mapping system. How does one polygonise these points? Core MapInfo does not have a Points to Polygon feature. SOPAC developed it.

The utilities can be grouped into families. Some are acting on windows, others on tables as a whole, some on the objects, some on the values, some add extra capabilities to MapInfo to transform it into a real GIS, allowing cross table analysis.

General

Print the co-ordinates of a point in various formats, test DDE exchange, transform ddmmss format to decimal degrees. Various version extended of a Grid maker, displaying the active set of symbols, printing the projection system of a table or a window, a generator of random numbers, display a Bitmap image, draw a scalebar in the cosmetic layer, draw shields.

Window

Clone a window, resize a window to allow precise copy and paste to other applications, copy the geographical characteristics of a window and paste it to another to make them identical, Named views, make an overview window, select all object on the screen, execute an application whose characteristics are found in the table, for example help file, with a topic, to document interactively a map.

Table

Import and Export ASCII values of geographical co-ordinates and one column on the model of XYZ to be contoured, extended version of the buffer selection, open and close multiple tables, delete all queries, combine layers, sort a table according to one or two column, update column values, manage those utilities in a consistent manner.

Objects

Re-sampling polygons by adding nodes, aggregate lines and points, break a multiple polygon region into several single polygon regions, clean the border of two adjacent polygons, draw a line by digitally entering its distance and bearing, connect points to make polylines or regions, disperse identical points to make them visible, measure distance to objects, draw a set of lines between two sets of points, import fixed length ASCII files, intersection of 2 regions, extract line within a region, extract nodes of polygons and Polylines, Displace object/ tables along a vector, displace a table or sets of tables to centre them on the 180º, transform lines to add arrows at one or both end(s), remove identical objects from a table.

The utilities are available from SOPAC.

In addition, SOPAC, who is dedicated to support the software installed in the region, is ready to respond to any request about new developments or provide advice on add on products.

images with 60 to 80 % overlap[1] . An radiometrically corrected image in digitised form or as photographic product costs $US 3,500 and covers 175 x 257 Km.

KFA-1000

KFA-1000 images are space-borne photographic products recorded from the Russian permanent space station MIR. The ground resolution is between 5 and 10 m because of the forward motion compensation of the camera and the images cover two spectral bands (see table 1). The space station is supplied with film material by spacecrafts, and theoretically data can be ordered from the German data distributing agencies GAF and Kaiser Trede. The image covers 100 x 100 Km and allows land use mapping at 1:25,000 scale.

MKF-6

The multispectral camera from ZEISS Jena is also based onboard the MIR station and is equipped with forward motion compensation too. The ground resolution of 25m allows a mapping at 1:50,000 scale. Of importance is the coverage of the blue band (see Table 1) which is essential for sediment mapping inshore and nearshore areas. The images are distributed by the German companies GAF and Kaiser Trede. The images cover 175 x 260 Km and cost about $200 per photo. The camera takes 6 images at one time, the ful set costs $US 1200.

MOMS-02

The sensor MOMS-02 is a push-broom scanner which will be placed in the Russian space station MIR in 1996. The sensor provides panchromatic data with 4.5m spatial resolution and multispectral data with 13.5 x 13.5 m ground resolution (details see article by Dr. Barbara Koch in Newsletter 9407). The price of data is not known yet and therefore not included in Table 2.

Summary of Satellite Data

Most inexperienced users believe that the key for interpreting satellite images is the spatial ground resolution. This article attempts to explain, that most requirements for map updates is for vegetation mapping related survey at 1:50,000 scale. A spatial resolution of 30 m is sufficient and more detailed ground resolution creates unnecessary problems during the data processing. What is required is a good spectral

[1]*other satellite provide stereo images as well, however, the stereo mapping and DTM establishment is not explained further, because topographic mapping is mostly completed and for map updating stereo mapping at 1:50,000 scale is not necessary.*

■ *Prakash Narayan, ORSTOM-Latical, BP A5 Nouméa*

IMAGE PROCESSING SIMPLIFIED

The purpose of this article is to outline the basics of Image Processing through a set of definitions.

Remote sensing

The whole group of mediums required to locate, identify and analyse objects or phenomena from a distance that is without any direct contact between the observing instrument and the object being observed. The element studied is the luminance which is the energy captured by the satellite of a certain part of the earth's surface at a given wavelength.

Principle

In earth observation, the remote sensing is limited to electromagnetic remote sensing where the signal is a form of light. Electromagnetic signal is the response to an excitement, such as to sun light.

Response

radioactive - light reflected, light emitted, light absorbed.

non radioactive- transformation/redistribution of the energy received.

Signal received depends on: the source, the object and its environment, spectral conditions and the observation geometry.

The useful electromagnetic spectrum intervals are limited by the atmosphere (atmospheric windows - low absorption-high transmission).

Visible near infra red: 0.4 - 2.2µm

Middle infra red thermic: 8 - 13µm

Microwaves: 1mm - 50cm

Modes

Two modes of remote sensing are.

Passive

In this mode, the system is a receiver.

Reflection: Sun is the source of energy thus it is only useable during the day, the sun's excitement depends on the sun angle and reflectivity is the response of a surrounding.

Emission: Thermic rays emitted by an object depend on its surrounding. Emissivity (reflectivity) is useable during day and as well at night. The utilisation domain is infra red and microwaves.

Active

The system acts as a source of energy as well as a receiver, similar to a radar.

In earth observation, the presence of clouds obstructs the observation of the earth's surface. It largely affects the visible and the infra red thermic domains.

Radiometry

Luminance (associated to a source) in relation to the intensity is to transform electromagnetic power of a targeted area on the earth's surface into a signal.

Emissivity is the emission of rays of natural surface at a given temperature. Emissivity is the essential characteristic property in the infra red thermic and microwaves domains.

Satellite

Description of the orbit - satellite movement

Elliptic: The altitudes of the closest and the furthest point determine the eccentricity of the ellipse.

resolution. In the visible light the vegetation cover reflects the light due to the content of the leaf pigments such as chlorophyll or Xantophyll. The reflection of the very near infrared portion of the light 0.7µm to 1.3µm is influenced by the cell structure while from 1.4µm to 2.6µm the cell water con-

Table 1: *Spectral resolution of multispectral space borne remote sensing information available for South Pacific Island Countries. The thermal band of Landsat TM is not mentioned and all panchromatic data is not shown in this table.*

Sensor	blue [µm]	green [µm]	green [µm]	red [µm]	red [µm]	infra red [µm]	infra red [µm]	infra red [µm]
Landsat TM	0.45-0.52		0.52-0.60		0.63-0.69	0.76-0.90	1.55-1.75	2.08-2.35
Landsat MSS			0.50-0.60		0.60-0.70	0.70-0.80	0.80-1.10	
SPOT XS			0.50-0.59		0.61-0.68	0.79-0.89		
JERS-1			0.52-0.60		0.63-0.69	0.79-0.86		
IRS-1C LISS			0.52-0.59		0.62-0.68	0.77-0.86	1.55-1.70	
KFA 1000			0.56-0.68		0.68-0.81			
MKF-6	0.46-0.50	0.52-0.56	0.58-0.62	0.64-0.68	0.70-0.74	0.79-0.89		
MOMS-02	0.44-0.51		0.53-0.58	0.64-0.68		0.77-0.81		

The inclination is the angle defined by the intersection of the orbit plan and the earth's equator plan. This intersection takes place according to the nodal lines.

Geo-stationary: The orbit has an inclination of zero (i=0) and a geo-stationary satellite revolves in the equator plan. It appears immobile to an observer on the earth's surface.

Helio-synchronous: The satellite's passage is observed at the same hour at the same latitudes thus it benefits the similar lighting conditions of that given hour.

Frequency of revisits: The period at which the satellite passes again over a given part of the earth's surface. It takes into consideration the earth's rotation about itself and the satellite's rotation around the earth.

Interferences of the orbit: These are atmospheric friction, earth not being sphere, attraction moon-sun, pressure of sun radiation.

Atmosphere

The electromagnetic signal that is detected by the detector on board a satellite travels through the various atmospheric layers before reaching the detector. The analysis of remotely sensed data requires that the ray-atmosphere interaction be taken into consideration. Three basic physical phenomena that intervene in the ray-atmosphere interaction are absorption, diffusion and refraction.

Errors

When image data is recorded by sensors on satellite or aircraft it can contain errors in geometry and in the measured brightness values of the pixels (i.e. radiometric errors).

Geometric errors arise from the relative motions of the satellite, its scanner and the curvature of the earth.

Radiometric errors arise from instruments used to record the data and from the effect of the atmosphere.

Correction

Geometric correction

Two techniques used to correct various types of geometric distortion present in a digital image data

- Establish models of the nature and the magnitude of the source of distortions. Use models to establish correction formulae.
- Establish mathematical relationship between the coordinates of pixels in an image and the corresponding coordinates of those points on the ground(via a map).

tent influences the reflection. Landsat TM covers these parts of the spectrum, most other sensors are limited to leaf pigments and cell structure. The blue part of the spectrum provides information about water sediments important for nearshore mapping. Table 1 shows the spectral bands covered by different multi spectral sensors.

Table 2: *Comparison of data potential and cost. The term "vegetation mapping" summarises all applications where multispectral information is required such as land use mapping, forest stratification and coastal mapping. The term infrastructure mapping summarises the mapping of linear features such as roads, creeks and rivers and topographic mapping (contour lines).*

Mapping Purpose	Mapping Scale	Data Type	Cost per Km²
vegetation mapping*	1:100,000	Landsat MSS	$US 0.03
vegetation mapping	1:100,000	Landsat TM	$US 0.14
vegetation mapping	1:100,000	SPOT XS	$US 0.73
vegetation mapping	1:100,000	IRS 1C	$US 0.15
vegetation mapping	1:100,000	JERS-1	$US 0.26
vegetation mapping	1:50,000	Landsat TM	$US 0.14
vegetation mapping	1:50,000	SPOT XS	$US 0.73
vegetation mapping	1:50,000	IRS 1C	$US 0.15
vegetation mapping	1:50,000	JERS-1	$US 0.26
vegetation mapping	1:50,000	MKF-6	$US 0.03
vegetation mapping	1:25,000	KFA-1000	$US 0.18
infrastructure mapping	1:25,000	SPOT Pan	$US 0.89
infrastructure mapping	1:25,000	IRS-1C Pan	$US 0.51
infrastructure mapping	1:25,000	TK-350	$US 0.08
infrastructure mapping	1:10,000	KVR-1000	$US 1.81

* recent MSS data is no longer available.

CONCLUSION AND RECOMMENDATION

If remote sensing data is required in South Pacific Island Countries, there are a number of different data sources which could be used. It is essential to evaluate the potential of space borne remote sensing data, because it will reduce the data costs significantly when compared with aerial photography and in many cases space-borne remote sensing data will fulfil the requirements. Space-borne data will continue to be on the market, because only 66% of the world's land surface is mapped at 1:50,000 scale and the average age of these maps are 43 years![2] If there are more users, the data will become cheaper. It is worth evaluating changing from conventional methods of map updating to satellite data application. It is also worth evaluating joint efforts to establish a mobile ground receiving station in the South Pacific. Landsat TM data can be received again and other satellite data can be recorded on every over-flight. The recording is not limited to the onboard tape storage capacity.

[2] *see Konecny, G. ZPF 2/1996*

Radiometric correction

- Radiometric correction procedures are specified to the nature of the distortion. That is to remove as much as possible the degrading effects or the atmosphere by modelling the scattering and absorption processes that take place.

Rectification

This is the process that makes the digital image correspond to some real world reference.

Geometric rectification: The digital image is made to point to the North.

Radiometric rectification: The technique used for radiometric rectification is image enhancement.

Image histogram

Each pixel of the image is examined for its brightness value. The histogram of an image is a graph of brightness values versus the number of pixels with that given brightness value. The histogram contains only radiometric and not spatial information. That is it only provides us with the information such as how many pixels belong to a given brightness value and not where these pixels are located in the image.

Image enhancement

This is the processes that makes spectral and spatial data more meaningful.

Radiometric enhancement is concerned with altering the contrast rang occupied by the pixel in an image. This involves determining a new brightness value for a pixel(by some specified algorithm) from its existing brightness value. They are referred to as to as point operations and can be implemented using look up tables. Technique used is histograms (stretching of histograms).

Geometric enhancement is to do with the image's perceived spatial or geometric character. This involves such operations as smoothing noise in the data, enhancing and highlighting edges, and detecting and enhancing lines. Geometric enhancement procedures invokes establishing new brightness values for a pixel by using the existing brightness of pixels over a specified neighbourhood of pixels. Techniques used are convolution and filters.

Mosaic

This is the process when a pair of contiguous images are joined together to form a mosaic. Histograms of the two images are compared to minimise the brightness value variation across the join. That is to say that the histograms of both images are made to "look alike". Histograms of the two images are made to "look alike" using radiometric enhancements techniques.

Environmental Manual for Power Development: New Public Domain Software introduced in the South Pacific

The Environmental Manual for Power Development (EM in short) is a multi-year and multi-donor project coordinated by the World Bank and jointly sponsored by the Governments of Germany, Switzerland, The Netherlands, and the United Kingdom

In February 1996, the European Union funded Pacific Regional Energy Programme PREP introduced the "Environmental Manual for Power Development" software during a regional training course which was held at the Forum Secretariat. Participants from Fiji, PNG, SPREP Western Samoa and the University of the South Pacific learnt to use the most recent tool for evaluating long term impacts of power/energy sector development.

The EM is a Windows-based **computerised tool** for the analysis of the environmental impacts of energy (mainly electricity) systems, and the cost tradeoffs associated with project alternatives (eg. low-sulphur fuel, flue gas desulphurisation, demand-side management, cogeneration, renewable energies).

The EM uses the comprehensive **life-cycle approach** to determine environmental impacts (from "cradle to grave"). The EM **generic database** offers a broad variety of information on energy systems - including costs, efficiency, and environmental impacts. It covers conventional fossil-fuel powerplants, boilers, and their supporting infrastructure (e.g. mining, refinery, transport), transmission and distribution systems, renewable energies (hydro, PV, biomass, wind etc.), and cogeneration and demand-side management technologies. Furthermore, emission control technologies are included.

The EM can be used for a wide range of applications - from "early screening" of energy projects under consideration, energy/environmental planning of utilities and countries to the cost impact analysis of setting different environmental standards.

THE CONCEPT OF LIFE-CYCLE ANALYSIS: CASE STUDY FIJI

Future Demand: The EM is tailored especially to deal with the problem of how a given demand for energy services can be met - and to find out about the consequences of doing so. These demands may concern electricity for end-uses like the requirements of the new Namosi copper mine which is currently discussed in Fiji. During the training course a case study of the Fiji Electricity Authority (FEA) interconnected system was developed. The first level of the analysis was to

... continued on page 24

For the actual mosaic processing, great care is taken to choose control points. Control points are coordinates of same identities that are found in both images.

Summary

- In the visible domain the reflectance is studied and in the infra red, thermic or microwave the emissivity is studied.
- After having acquired this information by the satellite of a certain part of the earth's surface, it is now time to do the inverse. That is, from the information acquired by the satellite we now try to determine what this information represents or symbolises on the earth's surface. The methodology used for this purpose is Image Processing
- When a digital image has been eliminated of only known errors and enhanced then comes the actual process of determining what these pixels represent in the image. The methodology used for this purpose is Classification.

■ *by Wolf Forstreuter, MSD-Forestry*

Utilisation of Bamboo Resources in Fiji GIS and Satellite Data Application

Introduction

Bamboo is an under utilised resource in Fiji while other countries use it in various industries such as craft, furniture or construction which has a recognised overseas market. There have been plans to create a small scale industry[1] in Fiji which would create employment and income from this renewable resource which is easy to harvest and transport on the rivers. Income could be also generated for villages and natural forest would be value-added without further destruction.

Before the potential marked can be investigated and small scale industries established, there are two questions to be answered:

1. Is there sufficient bamboo in Fiji?
2. Where are the bamboo resources and where are the water catchments necessary to transport sufficient bamboo to establish industries on the river mouths?

To both questions GIS and Remote Sensing are the appropriate tools to provide the answer.

Possibilities of Bamboo Mapping in Fiji

There are four main bamboo species in Fiji known by the local names "*Bitu wai", "Bitu kau", "Bitu Sanisani", "Bitu kau II"* which grow in the natural forests. The colour of the leaves enables specialists to differentiate bamboo areas from forest canopy through analysis of satellite data. It is possible to use Landsat TM[2] images to obtain the required separation. It may also be possible to use multispectral SPOT data as the colour difference is visible with the human eye which is also covered by the spectral bands of the SPOT sensor. However, this will require further investigation.

The only institution which could carry out such a mapping is the Management Services Division of the Forestry Department as the division is the custodian of the satellite data, has the knowledge required to analyse digital image data and staff with field experience. However, the workload of MSD does not allow extra jobs such as the production of "bamboo maps". An overseas student expressed interest in undertaking the job without salary and the Forestry Department provided the necessary work permit. However, due to the Christmas break, the permission arrived too late but investigations are on going to initiate a pilot project.

At a later stage, a bamboo distribution map could be a by-product of an improved forest stratification improvement which will enhance the information about the natural forest[3]. However, this activity will not start before 1997.

Requirements for GIS Analysis

A map showing the distribution of bamboo in Fiji would be a major step forward, but it still does not fulfil the information requirements to establish a small scale industry. It is necessary to know which water catchment can provide sufficient bamboo to install processing facilities at the river mouth.

GIS could assist in investigating and managing this project. A buffer analysis can highlight all areas of the bamboo distribution map which are close enough to the next creek or river to allow floating of the bamboo. Only bamboo areas of the buffer zone can be counted as a renewable resource of the catchment.

GIS can further assist by providing information about the *mataqali* of the buffer zone with suitable bamboo. Land ownership is an important issue in any utilisation of forest and technical support saves time and costs.

Bamboo is a renewable resource, but even bamboo can be over-utilised. In order to keep a bamboo processing small scale industry permanently running, bamboo harvest has to be planned. A GIS could record in which area the bamboo is harvested and can estimate the potential next harvest. The GIS also could correlate the floating potential of the river to the water-carriage of the river due to weather condition and river characteristics.

Summary and Recommendation

A furniture manufacturing industry could provide employment through small scale factories at river mouths where the materials are provided by villages harvesting the bamboo in a sustainable manner which creates income while preserving the rain forest.

Satellite remote sensing is a tool for bamboo mapping in Fiji and GIS can be used to manage the bamboo resource. A pilot project should be started at MSD-Forestry to evaluate the bamboo potential in Fiji.

[1] *For further questions please contact Lynda Miller, P.O.Box 15424, Fax 440-410*

[2] *See Tuinivanua, O. "Improving Fiji's Rainforest Classification Using Digital Satellite Images", this newsletter.*

[3] *African Tulip dominated forest, Raintrees and bamboo will be separated from the forest strata dense, medium dense and scattered forest.*

■ *Epi Rakita, MSD-Forestry & Franck Martin, SOPAC*

Differential GPS via INTERNET

Geographic Positioning Systems are too inaccurate for many applications due to deliberate errors introduced by a process known as selective availability. This process developed and controlled by the US Defence Department is designed to prevent terrorists or enemy forces from using the system to target or direct missiles which means that readings from a GPS are only correct to the limits of the instrument when the Defence Departments **turns off** selective availability.

So, when a user is confronted with readings from the GPS which have a possible 100 metre error and metre or sub-metre accuracy is needed, especially for survey work, the solution is to use a base station at a known location which records data from the constellation of satellites and later run software against the field GPS to remove selective availability errors.

Simple with current software and GPS hardware but who is going to install, maintain and operate a base station? Obviously a GPS user who needs a base station but also one who sees the benefit that this service can have for other users requiring "survey accurate" data where the cost for that user is minimal compared to implementing and operating his or her own base station.

MSD Forestry has such a base station and discussed with SOPAC how best to provide the base line or reference data for users throughout Fiji. The answer was to use the rapidly developing Internet service in Fiji and for SOPAC to set up a robot server to handle the dispatch of the data which is transferred to SOPAC from MSD when they receive a request to record data.

A picture, as they say, is worth a thousand words so please read on.

The fee will be FJD 40 for every day the customer wants to have the base station switched on. The customer has to download the files by Internet. He also can browse through a help function.

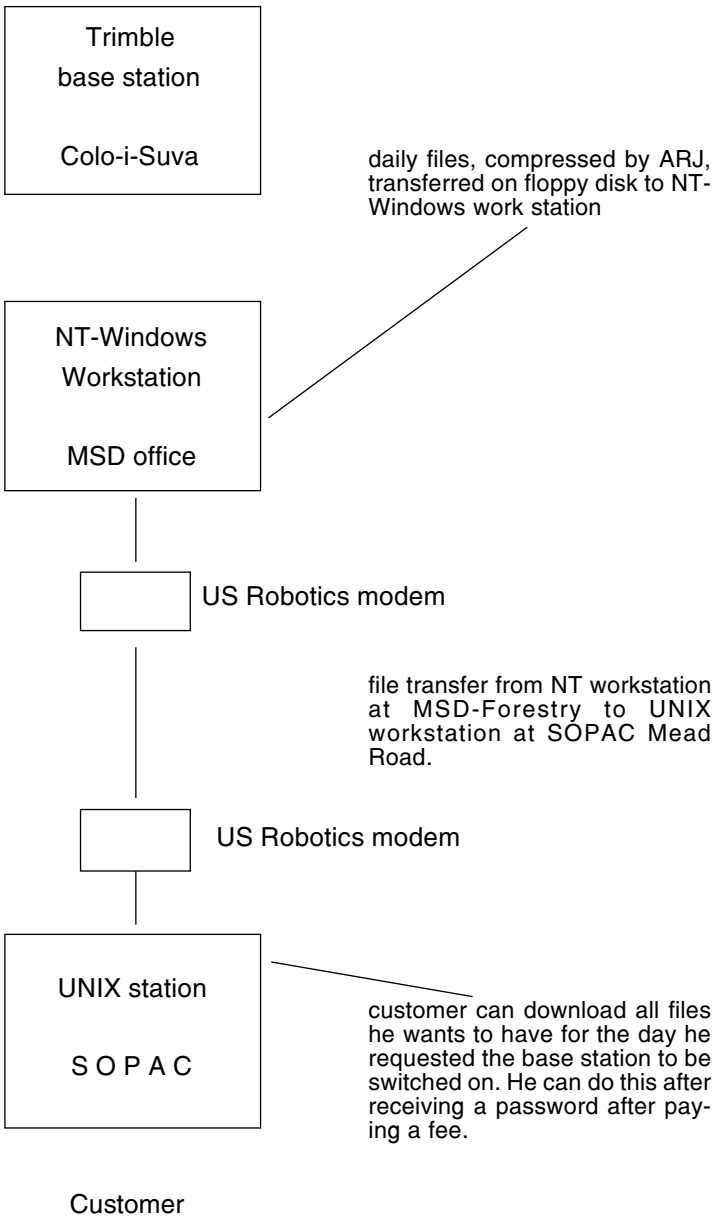
The system is managed by an automatic e-mail robot in SOPAC. This is a special e-mail address that process commands inserted in a message file.

To have more information send the message HELP to the e-mail address GPS-FJnet@sopac.org.fj. You will receive in return a help file explaining what other commands are available. It is important that you type only HELP in your message as the first line of your message. By default the subject is discarded.

Base station at MSD-Forestry, Colo-i-Suva

The base station at Colo-i-Suva is purchased from Trimble. The software version is 2.54-09, the receiver has 12 channels.

The exact location is 18° 03′ 25.2162″S , 178° 27′ 34.2811″E WGS84.



The accuracy within 300 km is 0.2 to 0.4 m in the X and Y-direction and 2 to 3 m in the Z-direction.

The files contain data for every hour.

The eight-dot-three file name indicate origin and time as follows:

XYMMDDHH.SSF
X = ID character => C for Colo-i-Suva station
Y = Year => 6 for 1996
MM = Month => 03 for March
DD = Day => 05 for 5th of March
HH = Hour => 14 for 2 pm

Important: Day and hour is given in Greenwich time, which is 12 hours behind local time!

For more information about the GPS files and the base station: wolfF@sopac.org.fj, Epi Vanigi, Phone: 322644
For more information about the e-mail robot: franck@sopac.org.fj

■ *Michel Larue, Mapping Geologist, SOPAC, michel@sopac.org.fj*

HOW DO I... ?
There must be an answer ...

You are in Tuvalu, Honiara, Manihiki or Suva, you have digital data that you want to put on a map. You have a PC, Microsoft Office, MapInfo, Winsurf and a laser printer. You know you can do it. You know you have everything you need. You have been sitting there for two days and it just does not work. It should but does not. Then you remember that you saw it working, and you regret that the training course, if there was one, was too short. You may think that those tools are not for you, not in such a remote place as yours. So what ?

If you were in New York or London, you would just call the office and get an answer. SOPAC can help you. It has long established itself as a link between the region, namely the Pacific Island Countries and the outside world. This is true now for desktop mapping.

Nowadays, instead of calling the shop, professionals encountering a difficulty just poke into a community of fellow users guessing that someone must have gone to the same problem before and have found a solution. In many cases it is true.

How does it work, another paper in this newsletter explains how discussion groups are organised and how you can get to them. But for that you need email, and may be you do not have it, yet. Or you have it, and you will try it and then soon you will find yourself jumping from under-informed to overloaded with useless discussions. Information revolution does not only bring solutions, it brings new problems. Sorting information is one of them.

It is where SOPAC intervenes. It receives and moderates several discussion groups. About MapInfo, SOPAC retrieves, analyse and organise questions and answers in an access database with keywords. For each topic, there is the basic question and the answers that have been provided. Sometimes it is only comments, or information.

All that is much needed in desktop mapping because the software business is not yet completely mature. As mentioned in another paper in this issue, Mapping software are compromise between power and learning curve. Also, GIS technology is a transverse one, used by a large community of users coming from all kind of origin. For instance guess who wrote the first book about MapInfo, a geographer? a surveyor? a geologist? no an archaeologist!

A real life example:

Subject: Selection between range in SQL
Question: How can I select a range of numbers, say all numbers between and including 1 and ten in Map Basic SQL. Microsoft SQL permits a "between" statement, is there an MapInfo equivalent?

Answer 1:

```
Select * from region  where a <= 10 and a
    >=1 into temp
```

"Yep, BETWEEN (undocumented apparently) works just like it does in the Microsoft SQL. You have to be a little careful if you are using it for thematic mapping (it won't get saved in the workspace) but other than that it is fine.
vaxcrshr@onramp.net
http://rampages.onramp.net/~vaxcrshr/index.htm"

Answer2:
You can do the following selects to get the results that you want.

```
Select * from tabname where col1 be-
tween 1 and 10 into Selection

Select * from tabname where col1 >= 1
And col1 <= 10 into Selection
```

Both selections will give the same results.

MapInfo Technical Support ☛

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Environmental Manual

define the demand: how much electricity and/or heat will be needed, how much capacity is required to meet the new customer loads. In case of the Namosi mine an additional 120 Megawatts will most likely be required to support operation of this venture.

Supply Options: Once the demand had been specified, suitable supply options were identified. The EM helped in comparing the consequences of such options with respect to environmental and cost impacts. Major options to meet a growing electricity demand in the FEA system were:

a) a new oil-fired powerplant

b) a new coal-fired powerplant.

c) an increase in using existing local resources such as bagasse, hydropower, and municipal waste;

d) an increase in using existing FEA diesel power plants together with solution c).

To find out about in the environmental and cost consequences of this investment, the group analysed data about the options: how much does it cost to built the plants, how much fuel will it take to deliver electricity, and what is the cost

All that is fine, but I am in Tuvalu, Honiara or Manihiki. Although the information is in Suva, how can I get it ? Just ask SOPAC, we will provide you with a solution, remember, we collected more than 1000 of them, this is our Hot Line concept, or with a copy of the data base file, in the state where it is.

If you think that MapInfo could do more for you, then here is the solution.

This is also true for the other software that SOPAC has selected and commited to support, i.e. Microsoft Office, Winsurf, Geographic Calculator.

of the fuel consumption ? The EM database supports the user in finding out the cost impacts of adding emission control technologies to the powerplants under consideration. The planner can make use of predefined datasets for those technologies to analyse both the cost and emission implications of adding mitigation devices.

Comprehensive Analysis: The Fuel-Cycle

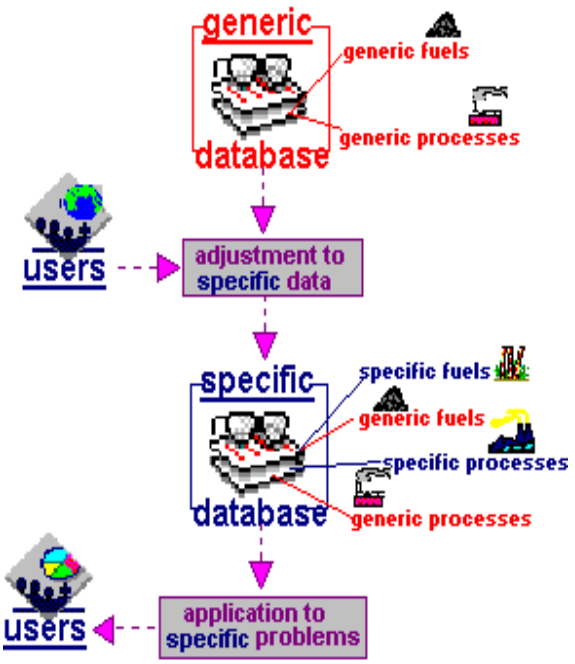
To burn imported oil and coal or local bagasse and municipal waste in the powerplants, the fuels must be extracted, transported, processed in and again transported to the powerplant. These activities also cause environmental impacts - but they do not occur at the powerplant, but *upstream* to it where the fuels are extracted, processed, and transported. The powerplant and its upstream links to supporting infrastructure are called a **fuel-cycle**. Along the fuel-cycle of energy systems, the flow of energy from the *resource* (e.g. oil deposit) to a useful *product* (e.g. electricity) passes though several *processes*, which all can have environmental impacts.

If a process like an oil-fired powerplant is to be compared to another process, e.g. a coal-fired powerplant or a bagasse fired plant, all these environmental impacts were taken into account for the options to allow for a complete comparison of all fuel-cycle impacts, i.e. the EM model had to cover the various impacts from all *upstream* processes linked to the powerplants. In the Fiji case study the comparison of impacts associated with the electricity production from the powerplants had to also take into account *downstream* processes like electricity transmission and distribution, in particular for the hydropower option where the resource location is different from the demand centre. All available options have been subjected to a scenario analysis. In the EM, a specified demand for electricity and/or heat, together with a (mix of) supply option(s) is called a *scenario*.

The Idea of Generic Data

To support users in comparing and analysing environmental and cost impacts of energy options and life-cycles, the EM model provides a comprehensive database in which relevant information for these tasks is already included. The user can retrieve such data records with a few keystrokes or mouse clicks, and can use the information for analytical work. But fuels and powerplants in the real world can differ significantly in their costs, operation modes, and environmental characteristics. Therefore, the EM database has to compromise between scope and adequacy on the one hand, and between user support and manageability on the other. The data records in the EM *generic database* are meant to be **typical** for real-world fuels (products) and powerplants, transmission lines, etc. (processes), but they do **not** refer to a certain country, region, or site. It is up to the user to create the specific data sets which are required to analyse the problem at hand. The generic data can always be used as a starting point or as a cross reference for plausibility checks.

ADJUSTMENT OF GENERIC EM DATA



During the training course the participants learnt to use the generic database, extracted data on appropriate fuels and processes and modified them to match the local conditions. There is now a first data set “Fiji Power System” which will be refined and further developed.

Future Activities

During the training course it was suggested to further promote the Environmental Manual as a planning software for power sector development under the Pacific Regional Energy Programme PREP. It is intended to establish a South Pacific user group which would interlink with the world wide user network of the software through Internet as well as through conventional communication linkages. The SPREP representative suggested to use the model to built a regional data base and perform green house gas inventories. It was further suggested to include the transport sector in the model.

Other suggestions are welcome! Please contact:

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Suva, Fiji
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Department of Energy, 386615
Department of Environment, 303515
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Ministry of Foreign Affairs, Civil Aviation & Meteorology
Ministry of Primary Industries, Drainage and Irrigation, 305546
Ministry of Primary Industries and Cooperatives, Land Use Section, 400262
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Public Works Department, Hydraulics Section, 303023
Public Works Department, Water and Sewerage Section, 315244
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South Pacific Applied Geoscience Commission (SOPAC), 370040
South Pacific Commission, 370021
South Seas Computing, 370875
Tuvalu Embassy, 301023
UNDP, Department of Humanitarian Affairs, 304942
UNDP, Regional Water and Sanitation Project, 302487
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University of the South Pacific, School of Pure and Applied Sciences, 302890
Wood & Jepson Consultants, 303361

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ORGANISATION/COUNTRY

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Bunnings Tree Farms Pty Ltd, Australia
CSIRO, Division of Fisheries, Australia
SPOT Imaging Services Pty Ltd, Australia
International Development Planning & Management Co, Canada
Ministry of Agriculture, Cook Islands
Ministry of Foreign Affairs, Cook Islands
Ministry of Marine Resources, Cook Islands
Department of Resources & Development, Federated States of Micronesia
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Ministry of Foreign Affairs & International Trade, Kiribati
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Marshall Islands Marine Resources Association, Marshall Islands
Ministry of Foreign Affairs, Marshall Islands
Centre ORSTOM de Noumea, New Caledonia
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South Pacific Commission (SPC), New Caledonia
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University of Otago, Spatial Information Research Centre, New Zealand
Department of Mining and Petroleum, Papua New Guinea
Department of Mining and Petroleum, Corporate Services Division, Papua New Guinea
Department of Mining and Petroleum, Minerals Division, Papua New Guinea
University of Papua New Guinea, Department of Geography, Papua New Guinea
Forum Fisheries Agency (FFA), Solomon Islands
Ministry of Foreign Affairs & Trade Relations, Solomon Islands
Ministry of Natural Resources, Forestry Division, Solomon Islands
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Lands and Survey Department, Vanuatu
Ministry of Foreign Affairs, External Trade & Immigration, Vanuatu
Apia Observatory, Western Samoa
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Department of Lands, Surveys and Environment, Western Samoa
Ministry of Foreign Affairs, Western Samoa
South Pacific Regional Environment Programme (SPREP), Western Samoa
Western Samoa Water Authority, Western Samoa.

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It would be appreciated if contributions could be sent on floppy disk in Word for Windows (preferred), Wordperfect for Windows or Wordperfect for DOS format.