NEWS

During regular monthly meetings prior to September there was insufficient time to cover the usual news updates in Fiji. However, the meeting held on 19 September at USP addressed this situation and updates were placed as point number one of the agenda.

SEPTEMBER MEETING

MRD has installed a network to link the computer of their different buildings. The Landslide Hazard Mapping Project is completed and provides a provisional landslide hazard zone map and a landslide inventory map for the east zone of Viti Levu. Rapid landslide hazard mapping using GIS/RS is practically possible in Fiji. Geochemical data have been digitised and will be merged with the digital geological map of Vanua Levu. The GIS-Documentation of all spatial data available at MRD has been completed.

MSD-Forestry. All plantation maps plotted by Lands Department at a scale 1:10,000 have been digitised. Stocking information derived from aerial photo interpretation has to be digitised and overlaid over plantation boundary before link to relational data bank can be established. GPS survey of plantation boundaries is ongoing in Vanua Levu. MSD-Forestry will establish an e-mail link via SOPAC to speed up the GPS data transfer from the field to Colo-i-Suva. Stereo plotting is continuing on logging areas in Viti Levu and Vanua Levu. Aerial Triangulation is continuing for logging areas and plantation photography. For the establishment of ground control points GPS is applied.

PWD. The urban utility forum is producing a film about GIS applications in Fiji.

SOPAC. Bathymetric data will soon be available on CD-ROM with the CD-ROM writer fully operational. Investigations are being conducted into the feasibility of setting up remote Local Area Networks connected by conventional telephone land lines with routers. The PEACESAT terminal equipment has arrived.

Agriculture Department (MAFF). Digitising of Fiji's soil map is completed for Viti Levu.

Private Sector. The GIS for Fiji's sugar Corporation will be MapInfo.

Discussion

Bruce Davis from (**USP**) presented the Regional GIS Status. On this one page overview USP was categorised a national organisation instead of a regional one. SOPAC was not mentioned as an organisation which applies GIS or remote sensing.

Many participants of the meeting could not understand why the report by **Dr Changchui** He (**ESCAP**) required six months to get to Fiji. Further, it was not understood why the workshop in February was mentioned as a national and not a regional workshop. SOPAC which provided time and effort to support this workshop was not mentioned. SOPAC did not receive a report. Concerns were expressed about the usefulness and relevance of this UN organisation.

SOPAC announced the integrated Coastal Management Plan for Nadi Bay.

MSD-Forestry showed a printout of the new cloud-free SPOT scene which was recently received at their office.

Presentations

Wolf Forstreuter (MSD-

GIS & REMOTE SENSING NEWS

FIJI USER GROUP, Number 12 (9503), November 1995

This is the third newsletter for 1995 and apologies are again in order for the small number of issues this year.

It is becoming increasingly important to monitor forest change through remote sensing techniques and this can be used to measure the "health" of this natural and essential resource as well as the interaction between forestry and the water supply and water catchment. Not only does excessive forest utilisation affect the quality of our water supply but it also affects the coastal zone which includes the critical reef system. Several articles address this issue. Forest Change Detection from MSD and Coastal Forests and Shorelines from SOPAC, while the interaction of water and forestry is highlighted in a proposal by MSD to use the water catchment as a management unit rather than the traditional district boundaries.

There has always been a shortage of satellite data for the South Pacific region which is mainly due to the limited data storage capacity of the satellites and the need for relay satellites or more ground stations. This can be overcome by a portable ground stations which can be moved to most locations in the region for capturing satellite data which is outlined in an article by MSD.

MSD also provides a basic introduction to GPS and highlights the limits of this technology which has transformed the survey field while another article compares raster and vector data where there is an ongoing need to clarify the role of each system in applied GIS and remote sensing.

SOPAC has installed a PEACESAT terminal which allows for voice and data transfer with all participating countries which is described in this newsletter with an emphasis on distance education. SOPAC has also distributed offshore data using CD-ROM which is rapidly becoming the standard for distribution of large datasets and software and this is also detailed. The rapid expansion of Internet services throughout the world and the acceptance of Internet e-mail as the foundation has led users in the South Pacific to expect service providers to offer e-mail as a basic service. While e-mail is traditionally used for messaging, it can readily be utilised for transferring data as attached files. In the first of a series of regular Internet articles, the basics of file transfer is explained.

Again we welcome contributions from national, regional and international users. Yes, you can reach us by Internet - see back page for the addresses!

Forstry) explained the benefits of a raster data based GIS for forest mapping at 1:50,000 scale. He detailed that ARC-INFO has limits which prevent this vector data based software from being able to perform many common forestry analysis tasks. Forestry must deal with scattered areas which create a high number of polygons. This cannot be handled by ARC-INFO. Overlay analysis is very time consuming if a vector data based system is applied. He demonstrated this limitation as well. Further, he mentioned the software problems during map plotting. Wolf also stated that MSD-Forestry was using vector data based systems (ARC-INFO and MicroStation) for mapping at 1:10,000 scale.

Bruce Davis (USP) demonstrated ArcView 1.0 software which allows the visualisation of tabular data with spatial data. It was noted that ArcView 1.0 is now public domain software.

Fabrice Williot (SOPAC) demonstrated IDRISI for Windows which is an image analysis and raster data GIS software. SOPAC is considering IDRISI as a low cost software application wherever raster data GIS or satellite data analysis is required. The software can handle dBASE files but limitations include a non-standard Windows interface and unsatisfactory performance which should be addressed in future releases.

Les Allinson (SOPAC) presented Data Maps which is included with Microsoft Excel 7.0 (Excel for Windows 95). This add-in is the result of Microsoft purchasing the license to use portions of the core technology from MapInfo Corporation. Data Maps is entirely adequate for simple thematic mapping but the version included under Excel clearly requires some necessary updates. It may be seen a sampler of GIS and may be an advertising tool to attract users requring a GIS with more features to select MapInfo.

Group Discussion

The GIS-Users decided that they will not give a software recommendation for a GIS package. The needs of the users are too diverse to propose a specific software. Also Wolf Forstreuter's presentation showed that well-recommended software can be inappropriate for many tasks. The group agreed that endorsement of a particular software or set of software should be postponed to after a comprehensive survey of all users was carried out.

OCTOBER MEETING

SOPAC gave a summary of important points from the annual session which was held at the Forum Secretariat Conference Centre from 26 September to 6 October.• It was announced at South Pacific Forum Meeting in Papua New Guinea that the Forum Secretariat would not be taking on further technical programs and it is possible that the United Nations Department of Humanitarian Affairs could be fully or partially located at SOPAC.

• Offshore data in MapInfo format distributed to all member countries on CD-ROM. Coastlines available at 1:250,000, bathymetry at 50 metre contours. EEZ and Territorial waters zones provided. Countries in whose waters the SOPACMAPS survey was carried out received additional data. This project was funded by European Union. Full description in next newsletter.

• PEACESAT is operational. It will allow voice and data transfer with other PEACESAT sites which are in all member countries of SOPAC. Full details in next newsletter.

• **MRD** was heavily involved in the SOPAC annual session. The computer network is now operational. The spatial data catalogue is now published.

• **Lukemine Enterprise** announced that two hand-held GPS units have been supplied to the private sector in Fiji and as the MapInfo agent in Fiji they will be receiving information on the next release of this product which is version 4.

• **FLIS** advised that: the data capture for Viti Levu title office is ongoing; the photo flight carried out from Brisbane will continue as soon as weather conditions improve; co-operation with NLTB continues with the Lautoka office providing files in DXF format; two trainees will receive one-week training at FLIS provided by the consultant company selling AREV software.

• **MSD Forestry** announced that: data capture of logging areas and hardwood plantation sizes is ongoing; forest change detection using new satellite data has started.

Presentations

• **Don Forbes (SOPAC)** gave a presentation on the correlation between land use, in particular deforestation, and coastal erosion. Examples were shown of the erosion in Kiribati, Federated States of Micronesia and Fiji. The use of aerial photography was outlined and the importance of this tool for contour mapping at 1:5000 scale is emphasised. Satellite images are also essential for mangrove type mapping, forestry change detection and shallow water mapping. The main software tool used for aerial photo analysis was GRASS. A full report will be provided in the next newsletter.

Subsequent discussion reinforced the critical need to preserve and catalogue a library of aerial photos and satellite images for detection of land use change. The need for detailed ground control data was also emphasised.

Wolf Forstreuter presented on behalf of **Joe Wakolo (MSD, Forestry),** the importance of water catchment as a forestry management unit which is more relevant to growth conditions due to similar soil and climatic environment. Water catchment units may be considered as the area in which there is a focal point, such as a river, for rainfall drainage. The river which collects the drainage reflects by its sediments the land use and the sylvicultural treatment of the forest cover within the catchment. Monitoring and planning could be rationalised using the catchment as the management unit as opposed to the current practice of district boundaries as

■ *by Wolf Forstreuter, MSD, Forestry*

Portable Satellite Ground Station (PGS) for the South Pacific

Need for Satellite Data

Fiji's natural rainforest inventory required the purchase of Landsat TM data to cover the main islands of the country. This data has been recorded by Landsat IV during 1991/1992. Aerial photographs were too expensive to cover forest area due to the high stand-by-cost of aircraft waiting for infrequent cloud free conditions. Continuous or regular cost effective forest monitoring is also needed as the Fiji Government cannot meet the high costs associated with aerial photographic surveys every three to five years. In addition to forestry applications, the Government agriculture sector has a requirement to monitor land-use outside forested areas.

The monitoring of the environment has become increasingly important for the responsible management of resources and providing information critical for disaster mitigation programs. This requires up-to-date data of the land surface, which cannot be provided by aerial photographs which are normally 10 times more costly.

Conventional Data Receiving and Portable Ground Station (PGS)

Landsat

During the natural forest inventory, the Landsat data was recorded by the satellite and downloaded to the receiving sta-

the management unit. A full report will be provided in the next newsletter.

In the following discussion it was noted that not only water level and quality measurements were available for rivers in Fiji but also groundwater level observations are being recorded. Further it was suggested that the management unit should further be divided into *geo-bioclimatic* [sic] *water catchment sub areas.*

Kemueli Masikerei, FLIS, reported on a the Fourth Regional Remote Sensing Seminar on Tropical Ecosystem Management held in the Philippines from 4 - 9 September. The seminar was funded by NASDA (partly ESCAP). Three UN-developed software packages for remote sensing and GIS were provided to participants. There were 61 participants and Kemueli was the only representative from the South Pacific. However, the next meeting will be held in Fiji. A committee will be formed including representatives from FLIS, MRD, MSD Forestry and SOPAC to discuss timing, venue and other details. Satellite data has to be available for use by participants for learning the application of this technology including disaster management, forestry monitoring, coastal management, agriculture and fisheries.

Ramen Shasan, Bureau of Statistics

The district boundaries of Fiji are being digitised under a UNFPA-funded project which will update the outdated district boundaries. The final output will enable the user to find the 1976, 1986 and 1996 census boundary. A census boundary indicates the area of the district. The spatial information is linked to a relational data base which containing details of households and people living in the area.

Questions were raised about the version of district boundaries. The district boundaries shown in the latest Lands Department topographic maps do not correspond with the district boundaries from the earlier British Department of Overseas Survey (DOS) maps. However, it appears that the DOS maps contain the latest revision of the district boundaries.

FLIS advised that there will be another release of Lands Department district boundaries in November 1995 which will reflect the latest revision. These boundaries will be available in DXF format with FMG grid.

Mataqali boundaries will not be available. The priority has changed to district boundaries.

Discussion

FLIS advised that a suggestion had been made for a committee to review and catalogue re-

tions in the USA via the relay satellite TDRS. However, the TM sensor onboard Landsat IV stopped working and the same sensor onboard Landsat V cannot be utilised for data recording over Fiji because this satellite can only download directly to ground stations.

SPOT

The SPOT satellite can store data on a tape recorder and download it while flying over the ground station in France but the storage capacity is limited and data receiving has to be programmed in advance. Another problem is the difficulty of forecasting Fiji's weather situation.

In addition:

- SPOT data has less information content because it does not cover the infrared bands which are important for forest type mapping;
- SPOT data is more costly than Landsat TM. TM data costs $ FJ 0.21 / km^2 SPOT data costs $ FJ 0.79/km^2, approximately four times more.

There are other satellites such as ***IRS*** (Indian Remote Sensing Satellites) ***ERS*** (European Remote Sensing Satellites), ***JERS*** (Japanese Earth Resource Satellite) or ***RADARSAT*** which can or could replace SPOT data. With the exception of RADARSAT and JERS, these satellites have no onboard tape facility and they require direct link to a ground station.

Fiji as well as the other South Pacific Island Countries are far away from major world population centres and are therefore not covered by a satellite data ground receiving station. The need for data by one country only would not cover the cost of such a station but there are PGS on the market which could fulfil the requirements of these countries.

A PGS as described below has a range of 4000 Km. If such a PGS is placed in Fiji it could receive data for Fiji, Vanuatu, Tonga, Niue, Tuvalu and Samoa. If the same station would be moved later to Nauru it would receive data for

SOPAC DATA ON CD-ROM

Offshore survey data was prepared on CD-ROM for distribution to the island member countries at the 24th Annual Session in Suva in October 1995. The data included bathymetry, coastlines, Exclusive Economic Zone and 12nm boundaries, and survey vessel tracks. In addition, Fiji, Solomon Islands, Tuvalu and Vanuatu were provided with data from SOPACMAPS which included bathymetry, seafloor images and survey vessel tracks from surveys carried out in their international waters. The data was predominantly in MapInfo format and a help file was supplied to assist in viewing and interpreting the data.

The size of data associated with Geographic Information Systems and in particular offshore surveys is far in excess of that which can be distributed practically on floppy disks and often too large to be able to store on the average user's hard drive. SOPAC identified the emerging standard in 1993 of using the audio CD for storing digital data where current capacities are approx. 650 Mb. Since that time, Infor-

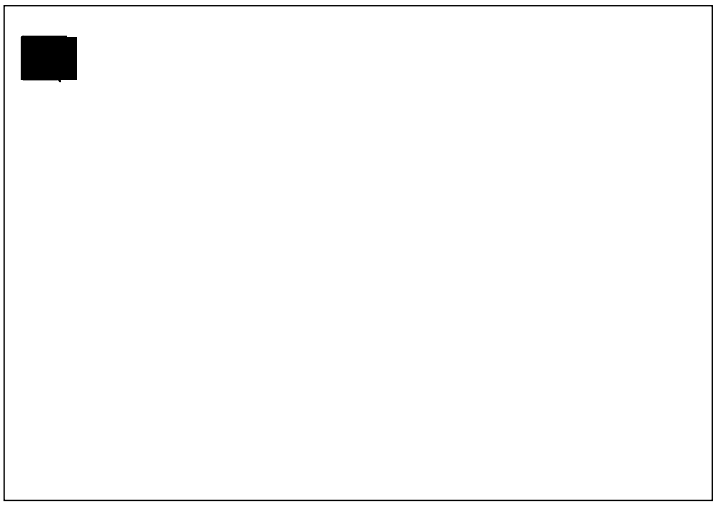

Figure 1. Receiving range of PGS in the South Pacific, assumed that the station moves from Fiji to Nauru and from there to Polynesia.

motely sensed satellite data for Fiji. The meeting highlighted the existing spatial data catalogues available from MSD Forestry and SOPAC which detail all available data for the country in an easily understandable format.

SOPAC reminded participants that there is an Internet e-mail news group named GIS-PACnet specialising in GIS and Remote Sensing matters of interest for the South Pacific. Users with Internet e-mail access should contact Franck Martin at SOPAC (franck@sopac.org.fj) for inclusion in this news group. MSD Forestry recently provided a 3D view from the ocean to Rakiraki which was created in the ERDAS software by applying a Landsat TM image over the Fiji DTM. The image was provided on the news group as an 18K bitmap which could be viewed in MS Word.

Next Meeting

To be held Tuesday 14 November at MSD Forestry. Mike Poidevin, who will be leaving Fiji end of November, will be presenting a summary of his work.

mation Systems in member countries have been upgraded with CD-ROM readers and these have been recommended in all new computer systems. It is anticipated that all island member countries already have or will very soon acquire CD-ROM readers to provide access to this current standard for data as well as software distribution.

SOPAC acknowledges the valuable support of the European Union (EU) in providing funding for acquiring the SOPACMAPS data as well as funding for computer based information systems to interpret this data. The Japanese International Co-operation Agency (JICA) is also acknowledged for funding support for hardware and software necessary for preparing CD-ROM's.

Background

In 1993, Information Systems were supplied to the eight ACP member countries to assist in the implementation of their SOPAC work programs under the EU funded South Pacific Marine Resources Program.

These Information Systems included computer hardware (desktop computer, laser printer and UPS), software, accessories and consumables where the software was Microsoft Office Professional as the core suite with MapInfo and Surfer for desktop mapping & GIS and gridding & contouring respectively.

In the following year, the 8 ACP member country Information Systems were upgraded with CD-ROM readers, additional memory for desktop computers and laser printers while software included upgrades to Windows for Workgroups, Microsoft Office Professional 4.3 and MapInfo 3.x.

This upgrade was in preparation for SOPAC to distribute data on CD-ROM, in particular the offshore survey data from SOPACMAPS in the waters of Fiji, Solomon Islands, Tuvalu and Vanuatu.

Summary of Data

The data can be classified into Common and SOPACMAPS:

Common - approx. size 100 Mb
- Bathymetry - (GEODAS)
- Coastlines - (DMA/NGDC)
- EEZ and 12 nm boundaries - (FFA/SOPAC)
- Vessel Surveys (Cruises) - (NGDC: 1,133; SOPAC: 394)

SOPACMAPS - approx. size 200 Mb
- Bathymetry
- DXF of Bathymetry
- Seafloor Images
- Vessel Survey tracks (MGD77)

The table across shows data on CD-ROM for each island member country.

the Solomon Islands, Federal States of Micronesia, Marshall Islands etc.

The IOSAT Transportable Satellite Imaging Terminal

The first known PGS was used in Kenya, in September 1994. This PGS was operated by TELEOS a partnership between Telespazio of Rome and EOSAT (USA). While this station can receive Landsat and IRS data, the raw data must be sent to EOSAT for conversion into a computer compatible product. IOSAT a Canadian Company has produced a PGS which is called Transportable Satellite Imaging Terminal (T-SIT). This T-SIT can already provide satellite data in computer compatible format or even images in the form of hard copy.

The T-SIT consist of several subsystems. A minimally 4.3 m auto-tracking antenna system (3800 km range) or optionally a 6.2 m dish (4000 km range) can be provided. A separate shelter encloses the antenna control system, the data acquisition system, a high speed SAR processor and an advanced workstation for further processing and display of the resulting imagery. Also included within the shelter are hardcopy production units, as well as power, environmental, and

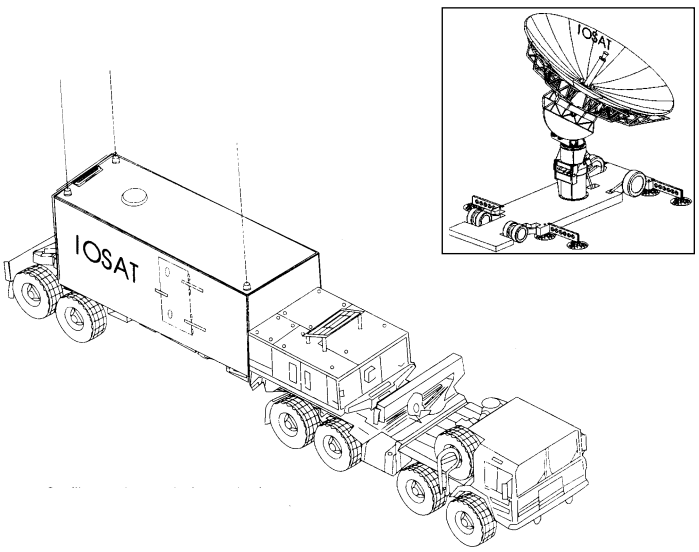

Figure 2. The T-SIT system ready for transport. Inset:IOSAT antenna.

communications subsystems. Such a T-SIT would cost $US 5 million. Additional money has to be available for the licensing fees.

Once on-site, a two-person field crew can assemble the antenna, and raise it to its operational position within two to five

DATA			
COUNTRY	**CODE**	**COMMON**	**SOPACMAPS**
Australia	AU	Yes	
Cook Islands	CK	Yes	
F.S.M.	FM	Yes	
Fiji	FJ	Yes	Yes[1]
Guam	GU	Yes	
Kiribati	KI	Yes	
Marshall Islands	MH	Yes	
New Caledonia	NC	Yes	
Niue	NU	Yes	
New Zealand	NZ	Yes	
French Polynesia	PF	Yes	
P.N.G.	PG	Yes	
Solomon Islands	SB	Yes	Yes
Tonga	TO	Yes	
Tuvalu	TV	Yes	Yes
Vanuatu	VU	Yes	Yes
Western Samoa	WS	Yes	
		17	**4**

Note [1] Includes additional bathymetry and imaging from waters South of Viti Levu

hours. The complete system can be transported by ship or C130 Hercules aircraft. The system is available in either trailer or skid mount, able to move independently from a harbour to the location designed for data receiving.

Recommendations

Should the South Pacific Island Countries acquire and operate a PGS without any financial support from aid donors, they will still have to pay for the received data. In order that this is undertaken effectively there is a need of an agreement for management of the PGS as well as data promotion and sharing. Data sharing does not mean data sharing between countries but between different departments of the same Government and a permit is required from the satellite data marketing companies such as EOSAT[1], SPOT image and RADARSAT.

Funding for the purchase of satellite data must be available before a PGS is acquired.

Activities which require and can benefit from satellite data, such as land use mapping, must be promoted to ensure that such data is available to the widest possible audience.

An agreement is necessary between the South Pacific Island Countries and an appropriate implementing agency with remote sensing expertise, such as SOPAC, to ensure the efficient operation of the PGS and subsequent data processing and distribution.

For further information about IOSAT Transportable Satellite Image Terminal ask MSD-Forestry Fax: +679 320311, e-mail WolfF@sopac.org.fj. There is a detailed article available provided by IOSAT marketing director M.J. Washer.

[1] *EOSAT already agreed by fax to MSD-Forestry*

■ *by Asesela Wata, MSD-Forestry*

IMPORT OF MATAQALI BOUNDARIES STORED AS DXF FILES

Introduction

The Management Services Division of the Forestry Department needs *mataqali* boundaries because:

- many requests about remaining forest cover are related to the area of *mataqalis;*
- the establishment of plantations mostly follows the lease area and this is related to *mataqali.*

The *mataqali* boundary is a political boundary which has a legal status. This status is documented on map sheets, which do not fit into the topographic map sheets. Any manual drawing into the topographic maps is difficult and creates inaccuracy. The Native Lands Trust Board (NLTB) is responsible for these boundaries and keeps them in a spatial data base. The Fiji Land Information Support Centre (FLIS) managed to write a program which converts this data to files which can be handled by MicroStation. MicroStation allows the export in DXF file format, which is the file format agreed to be the common format for Fiji. The first DXF files are now imported by the MSD.

Export of DXF Files at FLIS

From NLTB the files containing mataqali boundaries are exported to SIF file format. This files can be imported by MicroStation at FLIS. FLIS checks the accuracy of the stored information and exports the files to DXF format. In MicroStation, the ***File, Export, DXF or DWG menu*** has to be used to created a DXF ASCII file. It is not sufficient only saving the file as DXF!

Import of DXF Files to ARC-INFO

ARC-INFO has a module called DATA CONVERSION which translates about 10 different file formats to ARC-INFO coverages. This software package also helps to display information stored in different formats. Before converting a DXF file the program displays the file content. See Table 1 (overleaf).

Knowing the content of the DXF file it can be converted by the program DXFARC. The program allows to convert every layer separately. The name of the layer is displayed by DXFINFO as “Pattern Name”.

If the file is converted to an ARC-INFO coverage it has to be cleaned. All information beside the arc showing the *mataqali* boundary must be eliminated. Later it will be possible to import the boundary arcs only.

Import ARC-INFO Coverage to ERDAS

The ERDAS software package is also equipped with a data conversion module. ERDARC which is one of the programs converts ERDAS format files to and from ARC-INFO format files. The ARC-INFO coverage must be firstly converted to an ERDAS *.DIG file, which is still a vector data file. This file is an ASCII file an can be easily edited, GIS values can be changed, the file can be shifted within the FMG co-ordinate system etc.

To convert the *.DIG file into a raster layer the ERDAS program GIDPOLY is used. This gives all pixels with a poly-

***Table 1**. Content of a DXF file provided by NLTB via FLIS displayed with DXFINFO.*

LAYER NAME	ARCS	POINTS	TEXT	ATTRIB	INSERT	LEN	COLOR	LINETYPE
0	0	0	0	0	0	0	7	CONTINUOUS
CONSTRUCTION_CLA	0	0	0	0	0	0	7	CONTINUOUS
PATTERN_CLASS	0	0	0	0	0	0		CONTINUOUS
31	4	0	0	0	0	0	7	CONTINUOUS
30	4	0	0	0	0	0	7	CONTINUOUS
4	90	0	0	0	1	0	7	CONTINUOUS
10	5	0	0	0	0	0	7	CONTINUOUS
3	32	0	0	0	0	0	7	CONTINUOUS
1	15	0	0	0	0	0	7	CONTINUOUS
2	0	0	18	0	0	8	7	CONTINUOUS
50	0	0	51	0	0	6	7	CONTINUOUS
62	0	0	19	0	0	25	7	CONTINUOUS
11	0	0	1	0	0	9	7	CONTINUOUS
51	92	0	43	0	43	15	7	CONTINUOUS
ALL LAYERS	242	0	132	0	44	25		

gon (here *mataqali*) the GIS value stored as POLY_ID in the ARC-INFO coverage.

The ERDAS layer showing the mataqali areas (not boundaries!). This layer then can be overlayed by the forest type layer showing the forest types derived from satellite data interpretation (here digital analysis). The overlay process masks all areas out not belonging to the investigated *mataqali*. With the ERDAS program BSTATS the number of pixel belonging to each forest type can be counted. See Table 2.

The upper left corner has coordinate: 1875975, 3939050 The cell size is (X, Y): 25, 25 The number of hectares per cell is: 0.0625.

***Table 2**. The table shows the ERDAS printout of area calculation done for the forest types covering one mataqali.*

VALUE	POINTS	Hectares	DESCRIPTION
1	0.	0.000	Waterbodies
2	0.	0.000	Mangrove
3	1087.	67.937	Non Forest
4	0.	0.000	Hardwood Plantation
5	9272.	579.500	Softwood Plantation
6	0.	0.000	Coconut Plantation
7	0.	0.000	Obscured by Clouds
8	229.	14.312	Town Area
9	27.	1.687	Forest (low density)
10	0.	0.000	Forest (medium density)
11	0.	0.000	Forest (high density)
		663.436	Area of Mataqali

Results, Recommendations

With the *mataqali* boundary provided by NLTB via FLIS it is possible to calculate the area covered by different forest types. Knowing the area per forest type it is also possible to calculate the standing timber volume. However:

- the area calculation is based on satellite data analysis which was done on the scale 1:50,000. The scale is also standing for the accuracy, which will always be 1:50,000 even if the map is blown up to 1:25,000 or 1:10,000!
- if a standing timber volume will be calculated, the area is multiplied by the average standing volume per province (or district). The average may be different with the situation which can be found in this small subarea.

Satellite NEWS

EOSAT

- EOSAT is the exclusive distributor of Indian satellite data during the next 10 years. Launch IRS-1C in August, with IRS-1D to follow in 1996.
- EOSAT has collected data from IRS-1B since June 1994 and IRS-P2 since early this year.
- EOSAT is planning future ground stations worldwide. (GIS-World, April 1995)

EOSAT agreed with the European Space Agency and Radarsat International to distribute ERS-1 remote sensing radar data to U.S. customers. (*GIS-World, June 1995*).

Indian Remote Sensing Satellite

IRS-P3 will be launched in September 1995. This satellite will include an ocean colour instrument for oceanography. (GIS-World, April 1995). IRS-1C is scheduled to be launched in 1995 from the Baikonur Cosmodrom in Russia, a few weeks apart from launching IRS-P3. (*EOSAT Notes Summer 1995*)

SPOT

SPOT Asia announced the availability of a worldwide SPOT data catalogue on CD-ROM. Three disks cover all data from 1986 to June 1995. The data is supplied free of charge (excluding freight) fax 65-277-6231. (*GIS ASIA Pacific October 1995*)

High-Resolution Remote Sensing Companies Forms

The Newsletter reported earlier about the Eyeglass consortium in USA. Now a new venture called OrbView has been created with parts of Eyeglass and a Saudi Arabian investment company. This company will launch a satellite carrying a 1 meter panchromatic sensor and a 8 metre multispectral scanner by 1997. The satellite will fly in 460 km circular orbit with 14-day repeat cycle. (GIS User August-September 1995) (GIS-World, March 1995)

Another company called EarthWatch will launch its first satellite in the first quarter of 1996 with a 3 meter panchromatic and a 15 meter multicolour sensor. The second satellite in 1997 will have a 1 metre panchromatic and a 4 metre multicolour sensor (GIS-World, March 1995) The first three ground stations in Alaska, northern Scandinavia and Colorado. (*GIS-World, August 1995*)

The Geophysical & Environmental Research Corp. (GER), Latham, New York announced the GER Earth

Resource Observation System (GEROS) project, a system of up to six remote sensing satellites. Each satellite will be equipped with a multispectral sensor with 10 metre resolution and a panchromatic sensor with sharper resolution. The satellites will provide on-line images for agricultural production, environmental protection, forestry and land management. The first phase satellites and receiving station system is scheduled to become fully operational in 1998. (*GIS-World, September 1995*)

GPS Satellites to be upgraded
In the USA, four Government agencies, the U.S. National Oceanic and Atmospheric Administration (NOAA), the U.S. Environmental Protection Agency (EPA), the U.S. Geological Survey (USGS) and the National Biological Survey (NBS) partnered to jointly acquire and share Landsat TM satellite data. Through the joint acquisition and sharing of data, the government will save $US 4 million in direct costs. Another $US 26 million will be saved in indirect costs for joint analysis, archiving, management and distribution. (*GIS-World, May 1995*). Such a joint venture could be the model for South Pacific Island Countries to share costs of EOSAT distributed data (Landsat, IRS and JEERS). This may convince SPOT to allow data sharing between government agencies.

Geostationary Operational Environmental Satellite
First images of GOES-9 (Geostationary Operational Environmental Satellite) are available. The satellite was launched May 23 and provides eight images per hour. These images are available free. (*GIS-World, July 1995*)

Radarsat Antarctica Mapping Project
Because of its environmental significance the Radarsat Antarctica Mapping Project (RAMP) will create 3D maps of the Antarctica. RADARSAT's SAR data will allow to overcome difficulties such as harsh climate and clouds. It will be possible to map the continent in 18 days. The first mapping will be carried out in October 1996. A second mapping is scheduled three years later, which will enable to detect changes in the ice formation. (*GIS-World, August 1995*)

Oceansat
India has initiated a major program known as the Marine Remote Sensing Information System. The system is designed to provide data to Fishery. The main objective is the forecasting of potential fishing grounds. The next important user of the data provided by the system is the Meteorology sector. Cyclones mostly start from offshore, but they influence the inland crop production. The system will build and operate a satellite called Oceansat carrying sensors such as:

- an Ocean Colour Monitor to detect Chlorophyll concentration, suspended sediments, shallow water bathymetry, coastal currents, oil slicks and other pollution and internal waves;
- a scatterometer to detect wind speed and direction, heat budget, storm surge and sea level;
- an altimeter to measure wave height, ocean currents, sea surface topography, tides etc;
- a passive microwave radiometer to provide ionospheric corrections for the scatterometer;
- a thermal infrared radiometer to provide data about the sea surface temperature, cloud cover, coastal currents etc.

The satellite will be launched in 1998. The power system is designed to permit a global coverage. However, in order to receive data from all sensors, ground stations are necessary (*GIS User May-July 1995*).

RESURS
Digital image data is available from the third satellite of the Russian RESURS series. The sensors covers a wide swath (600 km). The repeat interval at the equator is 4 days which shortens with the latitude. The satellite has a onboard tape and the Swedish Space Corporation together with Russian organisations will look into opportunities to expand the network of direct receiving stations. The frequent repeat coverage make this satellite data interesting for monitoring agriculture, forests, coastal zones or snow cover (*GIS ASIA PACIFIC August 1995*).

■ *by Joe Wakolo, MSD, Forestry*

WATER CATCHMENT AS A MANAGEMENT UNIT ?

Introduction

Sustainable development of agricultural lands, as well as the environment conservation of our natural heritage, requires up-to-date information on landcover and landuse. Fiji's recent inventory of the natural forest cover adopted the district as its smallest information unit. This decision was made in order to divide a national inventory further than province level. For management decisions this is considered as to be too broad.

Activities are undertaken to include water catchments into the Geographic Information System (GIS) to be able to provide information on this level.

Relation of Water Catchments and Forest Cover

A water catchment is an area from which the water run off is collected by one river. A catchment can be divided into sub catchments, the definition is not very distinct. The last forest inventory (1969) defined only 28 catchments for Viti Levu excluding most of the Western Division (see Figure 1) and 31 catchments for Vanua Levu.

These catchments have an area of the order of 500 hectares for which forest conditions are less diverse than in a political district. The soil, mean rainfall and other climatic variables are similar which creates a similar impact to the plant growth. Thus, the species composition, stocking and the structure is more or less similar within a catchment. Further, the increment of timber volume is an important factor for forest planning and it is also similar within one catchment. The water catchment unit is more suitable for forest planning than a district which has a political boundary and is not related to natural features.

Forest provides much more than timber volume. Clean water with steady supply is probably the most important forest product. Natural forest cover provides a vegetation cover of mixed species and mixed age groups. The trees grow in several

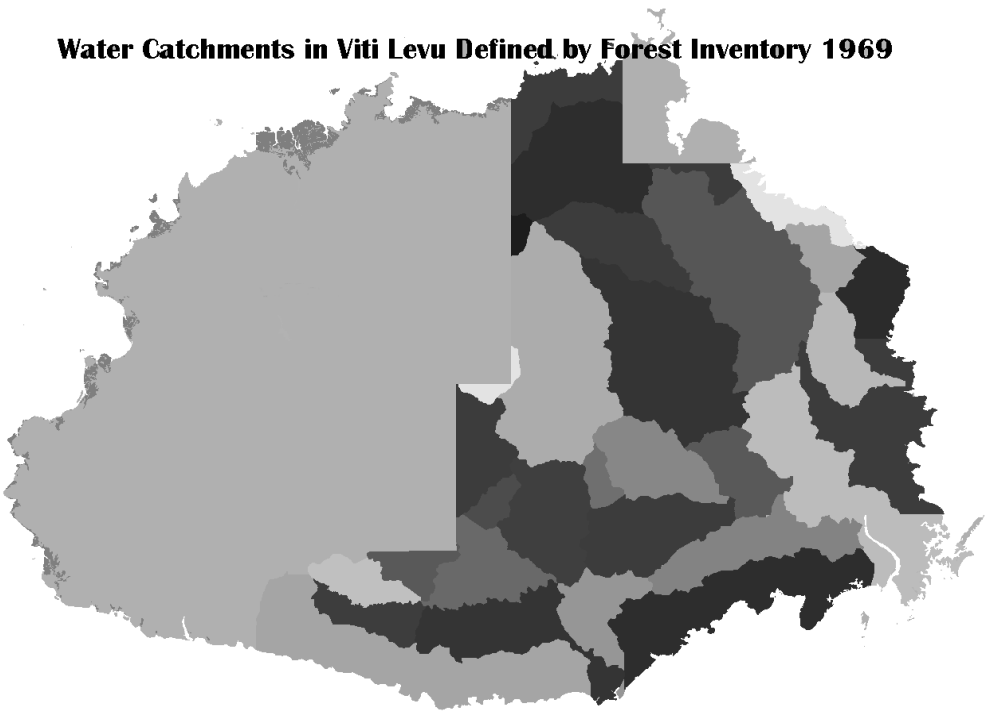

Figure 1. *Water catchment defined in Viti Levu by the forest inventory 1969. The western part of Viti Levu was not covered by the inventory. The catchments do not correspond with the catchment units of the Hydrology section of the Public Works Department.*

canopy stories and even the bottom underneath the trees is covered by bushes and smaller plants. Raindrops will first hit leaves of trees from the upper canopy story. Whenever a drop strikes a leave it is divided into smaller drops (interception) and only fine drizzle reaches the plants on the rainforest floor. A high percentage of the rain water goes as fog back into the air and the soil is moistened by the rest. There is comparatively little water runoff and in this way the soil can store a high amount of water.

Different sylvicultural treatments or different logging practices open the canopy in various intensities which influences the water run off. Even selective logging creates a change of water colour. Thus the sediment content of creeks and rivers can indicate forest activities within the catchment. In order to monitor forest activities the catchment area would be the appropriate unit and not the political district.

The correlation between different forest cover, slope, soil, rainfall on one side and water peaks and steady water flow on the other side is not known in Fiji, yet. However, it is currently being researched by the MSD management officer at the University of Freiburg and it seems already to be clear that there is a correlation. If so, the planning of land use and forest treatment will lead into a planning of water resources. The planning unit has to be the catchment and not the political district.

Possibilities of Change from Political District to Catchment as Forest Unit

At MSD-Forestry all spatial data is available per map sheet for the new Lands Department map sheet coverage. If there is a request of e.g. forest area per district an overlay analysis combines the layer "district" with the layer "forest cover". The author also digitised the water catchments used for the 1969 inventory. The combination of water catchment with any other spatial information stored at MSD is now possible.

The recent inventory of Fiji's natural forests created a data base of all forest field measurements and observations. More than 500 sample plots are stored in a dBASE IV data bank and can be used to calculate the mean timber volume, species composition, regeneration potential or potential of minor forest products available per province or district.

This data bank is easily accessible and a combination with the spatial information on catchments is possible. However, in order to operate the data base independently from the GIS additional software must be written.

Important: The nation wide inventory gives a detailed picture about Fiji's natural forest. It may be the case that in a small area such as a water catchment only a very limited number of plots have been measured. If water catchments are treated as forest management units additional forest measurements have to be carried out to reach a sufficient accuracy.

■ *by Franck Martin, SOPAC, Franck@sopac.org.fj*

Transferring files via e-mail

Fiji is starting to ride the information super highway, with a small car indeed, but a running car. The first tool we find on the highway is e-mail (electronic mail) and is the basic service used over Internet which allows for the transfer of text messages and attached files.

It doesn't need a full time connection. Depending on your e-mail software, your computer can allow you to type a message to be uploaded to the closest Internet node in one shot with all the messages previously typed. For instance sitting conformably at home, I'm using Microsoft Exchange to compose this message, in few minutes I will connect to my server in SOPAC, and this message will go on the Information Highway to reach you.

This configuration is indeed very easy to handle. Mostbasic users will use either a terminal session to connect to a host server where they will compose their mail, or use **uupc** software to compose it on their PC and send all the mail of the organisation to the closest Internet node.

Recommendations

There is sufficient grounds to justify the water catchment as a forest and land use management unit. However, nobody knows the correlation between Fiji's land use, forest treatment and the water flow and sediment content of the rivers. This has to be investigated and monitored as a joint action between Forestry and Public Works Department.

Further, the idea of catchment as being a forest management unit may require administrative restructure within the Forestry Department. This would need discussion on higher level than the Fiji GIS/RS User Group Meeting.

But let's get back to file transfer. You have noticed that you can send long messages with your mail system, and you can append at the end of the message any text file, providing you specify where the file starts and finishes, something like this:

--------CUT HERE------

<My text File>

--------CUT HERE------

You have also noticed that it is rather difficult to send accented characters with e-mail. With English you don't really notice this, but it is sometime surprising what will come out of a sentence like this one:

Le courrier éléctronique n'est pas défini pour les caractères accentués.

Imagine a Japanese trying to send an E-mail in his own language.

INTERNET WORLD IS IN 7 BITS

Why all these problems, because in the old times, modems and communication software was not reliable. You may know that computers store information in bytes which are composed of 8 bits (BInary digITS). To code all the Latin alphabet you need only 7 bits, and as the communications were not very good between computers, the 8th bit was used to check the accuracy of the seven others bits (parity bit). We are now with a problem, e-mail send only characters composed with 7 bits, the ASCII table. An ASCII table composed with characters coded with 8 bits is actually called Extended ASCII.

LET'S CODE

People overcame this problem by creating software that would transform a binary file (characters of 8 bytes) into an ASCII file (characters of 7 bits). The first one to have been created is UUencode/UUdecode (UU for Unix to Unix. Well, all INTERNET has been created on Unix computers!). This produces files that you will paste into your message like this:

This message has been UUencoded:

------CUT HERE------

AdGhjyyuyurYHntnyHYujymBGNbg65uTHtgh*l7ujrGWgt6y7uyj

RTY$&u5yujrgnrht7uyhGEYj5y7uiTGErtutuijEGWrfhtyjTJRT

------CUT HERE------

This system is still working today, and you can find UUencode and UUdecode on all platforms: Unix, Vax, PC, Mac. The disadvantage is the coded message doesn't contain information about the name of the file and which kind of file it is (sound, wordprocessor, image or whatever).

A second system was created on Macintoshes, called BINHEX, this system doesn't contain the disadvantages of UUencode as it stores file information with the coded file. Unfortunately this system has been mostly developed for Macintosh, even if you do find some BINHEX converters for PC and Unix.

The third system is becoming the standard. It is called MIME (Multipurpose Internet Mail Extensions). Any software MIME compliant is able, with the use of a table of correspondence, to decode any coded file and to play it with the right software. This is very useful as, everything is automatic, and platform independent. Unfortunately the specification of MIME implies that it is the mail software rather than an external utility which should decode and execute the file (for instance a sound file where I say "Hello!").

WHAT TO USE AND WHEN? UUencode/ BinHex/ Mime

UUdecode is the de-facto standard as anybody on any platform is able to retrieve a binary file. MIME is becoming the standard as it is much more user-friendly. If you have to send a binary file, and you don't know the mail capabilities of the recipient, always send the file as UUencoded. When you press the attach button or send file in your mail software be aware in which format the e-mail software will send it: UUencode, BINHEX, MIME.

GREAT OPPORTUNITIES

Exchanging files inside an e-mail opens you the possibility of doing some FTP (File Transfer Protocol) without FTP, doing some WWW (World Wide Web) without WWW. How come? Well, you have to go through a mail server. A mail server is a software, when it receives a message in a defined mailbox, will interpret the message as a list of commands. For instance send a message with no subject containing only HELP to mail-server@rtfm.mit.edu. The message you will be returned will explain how to receive files stored in this mail server. I'm sure you will find some other addresses to play with.

In fact mail-server@rtfm.mit.edu contains a comprehensive directory of available mailing lists, and other mail servers, several are related to GIS and RS.

Oh! I've forgotten! Most of the users who have only e-mail do not like to receive big files without their request. They often pay by the kbyte received!

Now you can ask those who offer such a service to send you the latest satellite image of your home.....

■ *by Wolf Forstreuter, MSD-Forestry*

Benefits of Raster Data Based GIS Systems for Forest Mapping at 1:50 000 Scale

Most GIS systems in the South Pacific Island Countries are vector data based such as MapInfo, Micro Station and ARC-INFO. The discussion about advantages or disadvantages of GIS software often neglects the fact that forest or land use planning deals with areas and not with linear features. Additionally, planning requires the comparison of different spatial data sources which makes overlay analysis technique necessary. Therefore, a raster data based GIS system such as ERDAS is an appropriate tool.

The Accuracy of Raster and Vector Data Based GIS
In order to compare the area accuracy at 1:50 000 scale raster layer (pixel size 25 x 25 m) with a 1:10 000 vector layer, a coverage of Naboutini plantation in Viti Levu, digitised with ARC-INFO, was imported into ERDAS.

A raster data based GIS cannot have point accuracy. The X-Y information of the represented grid system is stored for the centre of each pixel. For every polygon point which falls into a pixel the complete pixel has to be mapped. The outline of the imported plantation becomes jagged (see Figure 2). One pixel of 25 x 25 m represents an area of 0.0625 hectare which makes the area calculation inaccurate for small compartments. The polygons have also been imported as raster layer of 2.5 m pixel. The accuracy is comparable with the ARC-INFO coverage (see Figure 3). The area was calculated for the 25 m pixel layer and for the 2.5 m pixel layer by using ERDAS programs. Large compartments can be measured even on a 1:50 000 scale level with sufficient accuracy, see Figure 1.

The Texture at the Scale of 1:50 000
At cadastal level (1:5000) or forest management level 1:10 000 most land use classes form relatively large and homogenous patterns. A line indicating the boundary and a symbol in the centre of the area is sufficient to visualise it. This is impossible for most forest areas at 1:50 000 scale! Forest patches and grazing land form an inhomogenuous “salt and pepper effect”. Satellite information allows us to record and show this field reality. Even in large forest areas the frequent change between dense, medium dense, scattered and non forest forms an inhomogenuous texture of Fiji’s rainforest as recorded by a satellite sensor.

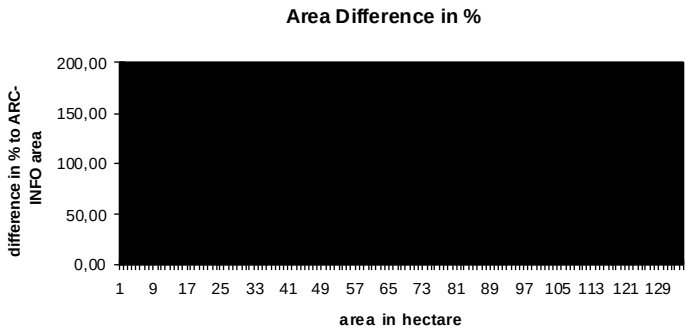

Figure 1. Comparison of area accuracy between an ARC-INFO coverage of Naboutini Plantation and a rasterised coverage of the same area at a) 1:50 000 scale 25 m pixel b) 10:10 000 scale 2.5 m pixel. The 25 m pixel show inaccuracy for areas less than 50 hectare whereas the area calculation using 2.5 m pixel is very accurate.

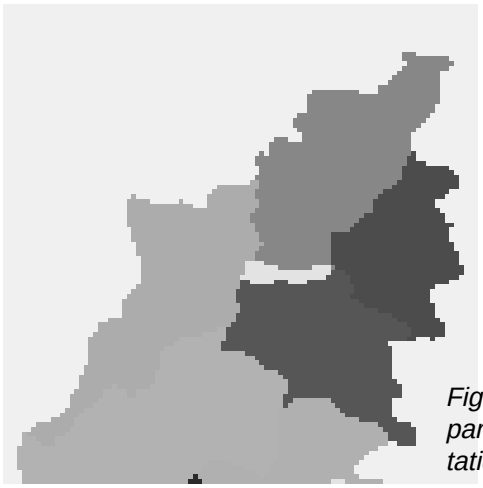

Figure 2. The northern part of Naboutini Plantation 25 m pixels.

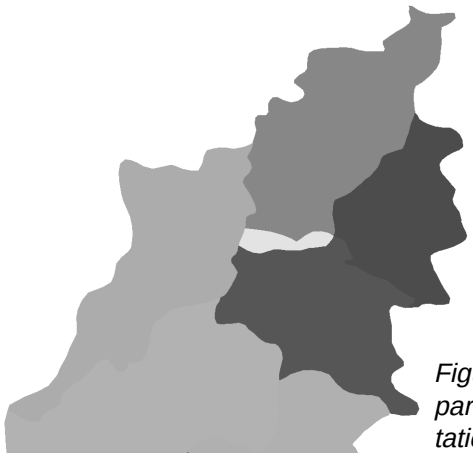

Figure 3. The northern part of Naboutini Plantation 2.5 m pixels.

Figure 4 shows the display of a forest function/forest type map which combines the five forest functions:

1) preserved forest
2) protection forest
3) multiple use forest
4) amenity plantation
5) timber production plantation

with the information content of the forest type map:

1) mangrove forest
2) hardwood plantation
3) pine plantation
4) coconut plantation
5) dense natural forest
6) medium dense natural forest
7) scattered natural forest
8) non forest

The combination shows 17 different classes visualised by different colour e.g. dense protection forest, medium dense pro-

■ *by Mike Poidevin, Project Cartographer, FFRTPP MSD-Forestry*

A Basic Understanding of GPS

Introduction
This article is designed to give a basic understanding of how the Global Positioning System (GPS) works, what it can be used for, and how accurate it is.

What is GPS ?
GPS is the Global Positioning System, developed by the US military during the 1980's. The system has 24 satellites that are positioned about 22 000 kilometres in space. The satellites follow a defined orbit, and the position of each is monitored from US military installations. The satellites are constantly transmitting information to earth. If a person on the ground has a receiver, then they are able to receive data from the satellites. This data allows the receiver to determine its position (ie. Latitude, Longitude and height).

The satellites are arranged to provide full coverage at any point on the earth's surface. The receivers vary from accurate survey instruments capable of tracking all satellites on the horizon, down to small hand held receivers used by boating enthusiasts, bush walkers, geologists etc. The US military use it as a guidance system in their aircraft, tanks, missiles, and for troop movement. It was this system that provided them with a clear military advantage during the Gulf war.

Their are two different types of GPS receivers. One allows access to the protected mode of GPS operation. This system is only available to the US military and their close allies. The second type of receiver allows access to the C/A code or coarse acquisition code. The C/A code receivers are available for civilian use. Since we only work with the C/A code receivers, the remainder of this paper refers to them.

How accurate is the system ?
A single receiver is only accurate to approximately 100 metres. (i.e. it will compute its position to within 100 metres of the known location). However, using differential GPS techniques (DGPS), a user can get down to centimetre accuracy.

What is Differential GPS ?
Differential GPS or DGPS as it is known, allows users to obtain a significant improvement in positioning accuracy compared to the results obtained from a single GPS unit.

DGPS requires the use of two GPS receivers, a computer and special software. One

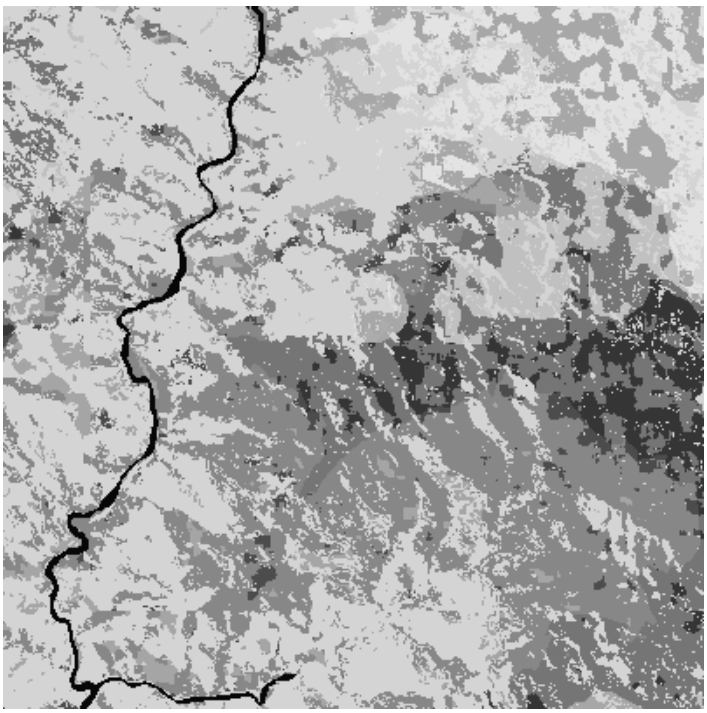

Figure 4. Display of a layer aggregated forest functions over forest types of map sheet M27 (10 x 10 km subset). This layer contains 17 different classes which create more than 5700 polygons within this subset!

tection forest, scattered protection forest...etc. The 10 by 10 km subset of the map sheet M27 was transferred from raster to vector data by the program DATA CONVERSION of ARC-INFO. The subset is only 1/12 of the complete map sheet, but the program was working for more than 40 minutes on a 4/86 33 MHz PC! More than 5700 polygon have been created! Any overlay analysis for a complete map sheet with ARC-INFO is out of question! The explained example is a practical case study and it is already a final product where the forest functions have been aggregated to areas of ± 100 hectare size. To reach the final product more than 10 layers have been overlaid.

Remote sensing information for forestry or land use planning must be up-to-date due to the fast change of land use. Digital satellite will replace increasingly aerial photography for this purpose. However, this information is stored in raster data layer.

Conclusion
For forest analysis at a scale of 1:10 000, overlay analysis does not play an important role and only a limited number of polygons is involved. Polygon based GIS systems are more appropriate. The Forestry Department is using MicroStation and ARC-INFO. However, at a scale of 1:50 000 ERDAS as a raster data based system is handling all steps of analysis and most steps of map compilation. A vector data based system would require a strong generalisation which does not reflect the forest reality of a scattered pattern.

Recommendations
Raster data based systems differ greatly to vector data based GIS. Whenever forest or land use analysis at a scale of 1:50 000 is carried out, a raster data based system has more advantages and should be taken into consideration. Designer and decision makers of GIS investment often have a surveying or cartographic background and think about lines and boundaries. Forestry and land use planners tend to deal with scattered areas and as soon as a scale of 1:50 000 or smaller is involved, raster data based systems should be considered.

receiver is set over an accurately surveyed control point, and is often referred to as the master or base station. The other unit is then free to roam in the field. This unit is often referred to as the rover unit.

The following is a very crude description of how the principle of DGPS works. The base station is continually computing its position at approximately 1 second intervals. At time (t1) it computes the following position C_lat, C_lon, C_hgt . Since the base station co-ordinates are known, a difference will apply.

Time t1	C_lat	C_lon	C_hgt
Known Co-ords	K_lat	K_lon	K_hgt
Difference	Δ_lat	Δ_lon	Δ_hgt

In the field, the rover unit computes its position at the same time t1. If we add the differences computed at the base station, then we significantly improve the accuracy of the rover position.

Of course, we need a computer to do DGPS. The software is also much more sophisticated than the block shift principle described above.

What Co-ordinate System is used by the GPS system ?
The GPS system uses the World Geodetic System 1984, commonly referred to as WGS-84. This is a Geocentric Datum, adopted for use by the US military. In order to work in other co-ordinate systems, transformations have to be done by the user. For example, here in Fiji we use the Fiji Map Grid (FMG), which is based on the WGS-72 spheroid definition. At Forestry, a set of seven transformation parameters have been computed from data supplied by the Fiji Dept. of Lands. These parameters are used within Forestry to directly compute transformations from WGS-84 co-ordinates directly to FMG. Again, all of this is transparent to the user, as the computer automatically produces the desired co-ordinates.

It is most important that the user takes great care in selecting the transformation parameters to be used, and that they are checked for the suitability of the work to be performed. For example, in Forestry, the parameters used are suited to the accuracy of the work we perform. The Dept. of Lands would use entirely different parameters for their geodetic control network. Likewise, if you are using GPS to do control surveys for boundary surveys, or other accurate positional work, you will need to derive your own parameters. Unfortunately, for accurate GPS work, a uniform set of transformation parameters cannot be used in Fiji.

■ *by Donald L Forbes, SOPAC*

COASTAL FORESTS AND SHORELINES IN THE SOUTH PACIFIC

Introduction
Tropical island shores have a number of distinctive attributes that call for special attention in drawing up coastal management and protection strategies for the south and central Pacific. These include carbonate reefs that function both as primary coastal protection structures and as principal sources of beach sand in many situations. Extensive coastal mangrove stands are also important in some areas. Coastal stability may be adversely affected by management practices such as clear-cut logging, which may lead to increased sedimentation on fringing reefs, or removal of mangroves, which may result in shoreline erosion. Nearshore circulation and coastal sedimentation processes may also be relevant to mangrove rehabilitation or planting programs.

The South Pacific Applied Geoscience Commission [SOPAC]
SOPAC has an active work program on coastal erosion andsedimentation processes in many of the island member states. Work is carried out in response to specific requests for advice, usually where problems have arisen in relation to storm damage, infrastructure loss, adverse management practices, or proposed developments with anticipated impact on the coastal system. Other issues include beach mining, reef blasting, mangrove destruction, marine aggregate extraction, shore protection, and harbour development, as well as more general questions of shore stability in relation to wave exposure, sediment budgets, sea-level rise, and other environmental factors. The remote sensing and GIS activities of SOPAC focus on applications in the areas of geological hazards (such as volcanic eruptions, earthquakes, tsunamis, cyclones and shore damage) and mapping requirements for all aspects of the work program.

Forestry and the coast
Except in the matter of mangrove habitat, the link between forestry and coastal environments has received limited attention in the South Pacific. In other jurisdictions (e.g. western Canada), there is a history of co-ordination to address issues such as degradation of salmon habitat due to sedimentation from clear-cut logging on steep slopes, while elsewhere (particularly in Europe) the conservation of backshore vegetation (including woodland) is recognised as a fundamental issue in coastal dune stabilisation.

In the South Pacific, we can identify several areas of common interest between coastal geoscience and forestry. These fall into two categories:

■ ***natural systems issues***
- reef conservation (including sedimentation impacts)
- backshore vegetation for dune and shoreline stabilisation
- mangrove habitat and conservation

■ ***methodological and capacity-building issues***
- geodesy, positioning, and mapping
- remote sensing (aerial photography and satellite imagery)
- image processing and GIS for shoreline and forest-cover change detection

Several examples of natural

■ *by Joe Wakolo, MSD-Forestry*

Visual Forest Change Detection with ERDAS Imagine

Introduction

The significance of tropical forest vegetation in South Pacific Island countries is increasingly recognised due to their functions as stabilisers and regulators of micro and macro climates, soil fertility and water conservation, and as producers of various raw materials. The situation has to be monitored even with limited forest personnel.

Forest Change Detection is a process of reviewing forest areas over a period of time to check for changes whether increase or decrease in the extent of forest cover. Satellite remote sensing and GIS techniques can contribute to a great extent to an appropriate management of the tropical environment. Satellite data is much cheaper per unit area and is readily available when compared with aerial photography.

GTZ (German Aid) contributed favourably by providing funding for the purchase of SPOT data to continue forest monitoring.

Method of Comparison

The Management Services Division started to compare the forest cover mapped with Landsat TM data recorded in 1991, with recent SPOT recorded in June 1995. The scenes were geometrically corrected to the 1:50 000 map sheets O28, O29 and O23 and cut to map sheet size. The areas are considered ideal for a tropical environment because various types of vegetation occur within these areas. The approximate area of each sheet is 120 000 hectares.

Prior to visual interpretation SPOT data was enhanced to improve interpretability and two enhancement techniques were applied which consisted of:

- simple contrast

system interactions can be cited from various parts of the South Pacific region. Reefs represent the primary coastal protection structures on tropical island coasts and any threat to their integrity (including sedimentation resulting from logging-induced erosion) is a concern. Vegetation removal has been identified as a contributing factor in accelerated shoreline erosion at some sites and mangrove is recognised as an effective sediment stabiliser and shoreline buffer, removal of which can lead to erosion problems where none existed before.

Collaboration between SOPAC and Management Services Division of Fiji Forestry has highlighted a number of areas of common ground in the fields of positioning, remote sensing, and image processing. Satellite image processing for mangrove detection requires data in the infrared part of the spectrum, available from Landsat but not from SPOT. Coastal erosion and sedimentation can be monitored using high-resolution SPOT imagery in areas of rapid change, where sub-pixel resolution can be achieved by averaging techniques. However, most applications in the South Pacific require large-scale aerial photography (e.g. Gillie, 1993; Forbes & Hosoi, 1995).

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■ *by Leslie Allinson, SOPAC*

PEACESAT AT SOPAC

PACIFIC ISLANDS RESOURCE AND ENVIRONMENT INFORMATION (PIREIS)

On Friday 22 September 1995 at 10:30 am, voice communications was first established between SOPAC and PEACESAT Headquarters, Honolulu, using the newly acquired 3 metre dish ground station. This initial voice exchange was the beginning of a new communications link between Secretariat and the member countries and the commencement of an innovative service (PIREIS) which will provide a gateway to wider and emerging communications options.

The equipment to realise this goal was provided under the generous support of the United States Department of State through assistance from the Bureau of Oceans and International and Scientific Affairs.

What is PEACESAT ?

The **P**an-Pacific **E**ducation **a**nd **C**ommunications **E**xperiments by **Sat**ellite (PEACESAT) program was initiated in 1971 to experiment with distance learning, emergency information, and teleconferencing applications through the use of a single push-to-talk voice communication using the ATS-1 satellite by sites in the Pacific. In 1985, the PEACESAT program became temporarily limited when the ATS-1 satellite station keeping fuel became exhausted and could no longer support the needs of its users.

The PEACESAT program was re-established in 1989 through the use of the National Oceanic and Atmospheric Administration's (NOAA) GOES-3 satellite and sponsored by the U.S. Congress and the Department of Commerce's National Telecommunications and Information Administration (NTIA),. Since the formal opening in 1992, the PEACESAT regional telecommunications alliance has grown to more than 40 sites in 25 countries.

PEACESAT is a successful non-commercial communications service and due to increasing demand for additional sites has formulated a Site Improvement Plan which was first presented in 1994 and which will replace the existing mesh network analogue network with digital to provide more effective use of the satellite bandwidth.

Figure 1. Monitor display of forest cover file (left) mapped with Landsat TM data recorded 1991 and display of SPOT image (right) recorded 1995, both for a part of map sheet O23 Rukuruku Bay (Vanua Levu). The cursor is moving simultaneously in both parts of the display. ERDAS Imagine allows such a link of two geo-referenced files.

- histogram contrast

The degree of contrast was done on a trial and error basis until the desired contrast was achieved.

ERDAS imagine provides the display of two geocoded files in two windows on one screen and the program displays the cursor simultaneously on the same location on either window. This enables the visual comparison of the two areas using the cursor. Even small areas can be visually compared. (see Figure 1).

Results

On map sheet 023 (Rukuruku Bay) in Vanua Levu an area of approximately 4 hectares was found to have been clear felled since the 1991 map. On map sheet O28 (Nausori) an area of approximately 8 hectares of additional forest was detected. The spectral signatures seem to indicate that this area is invaded by African Tulips an introduced and very fast growing species (see article by Osea Tuinivanua, Newsletter 8 September 1994 and Newsletter 10 February 1995). Field checks have to confirm the situation. In general there was not much change detected in the three map sheets.

The method using SPOT data and visual comparison concentrated on the change from forest to non forest and vice versa. The area estimation could be improved by applying ratio images, which can be overlayed directly on the forest cover map produced with Landsat TM data. However, most logging does not remove the forest canopy completely. To notice a change from dense to scattered or even to medium dense forest other techniques have to be adopted. Further, it is not sure if SPOT data is sufficient for such a job because of its limited infrared information.

Recommendations

Satellite data is an appropriate tool for forest cover change detection. However, this data is still too expensive to be used by the Forestry Department alone. Other departments such as Agriculture or Environment should use the same data, which needs further image analysis facilities as well as an agreement of data sharing with the satellite data selling companies. Further, transportable ground receiving station based regularly in Fiji would provide additional data.

The new services will include the upgrade of existing 3 metre terminals and the deployment of eight 6 metre Hub sites throughout the Pacific which will have sufficient bandwidth to serve as concentrators for 3 metre terminals and provide multiple voice and data channels plus video conferencing facilities.

Why did SOPAC identify PEACESAT ?

SOPAC has been fully aware of the benefits for the region through the use of PEACESAT by the Forum Fisheries Agency which is the regional organisation most closely aligned with SOPAC's work program.

FFA identified PEACESAT as an appropriate regional communications network in the mid 1980s and through a European Union funded 5 year project implemented the South Pacific Regional Tuna Fisheries Management Information Service. This pioneer service was achieved through the installation of 14 PEACESAT terminals in FFA's member countries and the project was completed in 1993. The service which is now called FFANet has provided communications access for the majority of the Pacific Island Countries who have greatly benefited from this initiative.

FFANet has provided PEACESAT terminals in all of the Pacific Island member countries of SOPAC and in several countries the terminal is located at the government sector which SOPAC serves. See Attachment A which lists terminals by country where the most likely access sites are identified.

FFA has been using PEACESAT as a communications backbone to progressively provide Internet e-mail to its member countries through Microsoft Mail and has encouraged the use of the in-country post-offices by a wider user base provisional to endorsement by the national site. There will however be countries who will use SOPAC as the prime access point to Internet e-mail and there will naturally be a reciprocal arrangement for e-mail routing.

It should be noted that FFA batches its Internet e-mail traffic via

LIST OF PEACESAT STATIONS BY COUNTRY[1]

Site [2]	Terminals	Institution	Country
Pago Pago	1	American Samoa Community College	American Samoa
Radio Australia	1	Radio Australia, Melbourne	Australia
Cook Islands Fisheries	1	Ministry of Marine Resources	Cook Islands
Rarotonga	1	Department of Education	Cook Islands
Chuuk	1	Department of Education	Federated States of Micronesia
Kosrae	1	Department of Education	Federated States of Micronesia
Pohnpei CCM	1	Community College of Micronesia	Federated States of Micronesia
Pohnpei MMA	1	Micronesian Maritime Authority	Federated States of Micronesia
Yap	1	Department of Education	Federated States of Micronesia
Fiji Fisheries	1	Fisheries Division	Fiji
SOPAC Suva	1	South Pacific Applied Geoscience Commission	Fiji
SPC Suva	1	South Pacific Commission	Fiji
Guam	2	University of Guam	Guam
Kiribati Fisheries	1	Fisheries Department	Kiribati
Majuro	1	College of the Marshall Islands	Marshall Islands
Majuro Fisheries	1	Fisheries Department	Marshall Islands
Nauru Fisheries	1	Fisheries Department	Nauru
SPC Noumea	1	South Pacific Commission	New Caledonia
MAS Wellington	1	Marine Air Systems	New Zealand
Wellington Poly	1	Wellington Polytechnic	New Zealand
Niue	1	Department of Agriculture Forests and Fisheries	Niue
Rota NMC	1	Northern Marianas College	Northern Mariana Islands
Saipan NMC	1	Northern Marianas College	Northern Mariana Islands
Saipan PSS	1	Public School System	Northern Mariana Islands
Palau Education	1	Department of Education	Palau
Palau Fisheries	1	Fisheries Department	Palau
PNG Fisheries	1	Department of Fisheries	Papua New Guinea
Unitech	1	University of Technology (Lae)	Papua New Guinea
Honiara	2	Forum Fisheries Agency	Solomon Islands
Tonga Education	1	Department of Education	Tonga
Tonga Fisheries	1	Department of Fisheries	Tonga
Tuvalu	1	Fisheries Department	Tuvalu
Kokee Park	1	GOES-3 Telemetry Station, Hawaii	United States of America
Anderson Valley	1	AV Agriculture Institute, CA	United States of America
Honolulu	2	University of Hawaii at Manoa (Oahu)	United States of America
UH Hilo	1	University of Hawaii at Hilo (Hawaii)	United States of America
Port Vila Fisheries	1	Fisheries Department	Vanuatu
Alafua	1	University of the South Pacific	Western Samoa
Apia Fisheries	1	Department of Fisheries	Western Samoa
Malifa	1	National University of Samoa	Western Samoa
	43 [3]		

[1] The list is based on data provided by PEACSAT Headquarters in 1994 and the addition of the SOPAC site. There may have been other sites added during the past twelve months.

[2] Site and Station are used interchangeably.

[3] Total number of terminals where some stations have multiple terminals but same identifier.

PEACESAT HQ, Honolulu, every night while SOPAC uses the USP gateway.

The forthcoming digital services are the logical successor to the existing analogue system and SOPAC specified a digital upgrade to the normal 3 metre terminal when identifying the equipment.

The above led SOPAC to develop the Pacific Islands Resource and Environment Information Service which uses PEACESAT as the communications vehicle.

Will there be a PEACESAT Hub Site in Fiji ?
In February 1995, SOPAC submitted a joint application with the SPC Suva to reserve one of the eight hub sites for Fiji. The application was approved by the PEACESAT committee and it should be noted that only two countries outside of the ex-US Trust Territories received approval where the other was Solomon Islands with an application submitted by FFA. SPC Suva has requested to be the host site for the Fiji PEACESAT Hub and has committed funding for the position of manager. This Hub will serve the needs of the wider community of international, regional and NGOs located in Fiji and will provide a valuable service for this country. For further information see *Proposal to Become a PEACESAT Hub Site, SOPAC Miscellaneous Report 189.*

What will SOPAC use PIREIS for ?
PIREIS will provide formal distance education in the Earth Sciences, Water & Sanitation, Disaster Mitigation programs and assistance with the fellowship programs and other training areas such as Offshore, Coastal, Mapping, Minerals and Hydrocarbons as well as core units such as Cartography and Information Technology.

While training will be a major component of PIERIS, access to the Regional Data Centre, distribution of data, support for GIS and Remote Sensing users as well as IT development and management will be a focus for the service.

Another goal is the provision of Internet e-mail to the island countries which must be realised within the next twelve months and will be achieved though close co-operation with other regional organisations.

PEACESAT sites are committed to provide voice and data services to community groups and SOPAC has already received enquiries from eligible organisations for regional communications.

Finally, as has occurred in the past, PEACESAT may be one of the few if not the only international communications link for an island country following a natural disaster and every site is committed to this public service.

Summary
The PEACESAT service provides voice and data communications for non-commercial use and is an ideal communications tool for the government sectors of the Pacific Island countries where relatively small international traffic has led to high tariff costs depriving those countries from access to information services essential for resource management.

PIREIS will address this need and will provide an Internet gateway, conferencing and general voice communications facility, distance education service, possible alternative communications route in case of natural disaster as well as routine data transfer.

SOPAC acknowledges the valuable assistance by the Bureau of Oceans and International and Scientific Affairs in securing the necessary funding from the United States Department of State to realise this communications service.

Requests for inclusion in the mailing list for this newsletter as well as the submission of articles for publication should be sent to:

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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.

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