G I S

REMOTE SENSING NEWS

FIJI USER GROUP, Number 15 (9602), August 1996

Welcome to the second newsletter for this year and again the net or the web or the superhighway is an important issue. An “on ramp” to this information highway is coming to or has arrived at a service provider near you. It’s here to stay but it’s a moving target and information providers, information publishers and information consumers must get aboard as soon as possible and tool up to get the benefits of information exchange.

SOPAC in Suva has built the first intranet service in Fiji and the content is growing rapidly with other sites connecting every week and an international gateway is imminent. New services (content) were started in mid August which allows users to view available satellite images of the region as well as access a meta GIS database. This is described in “WWW and GIS - a case study” with details on how you can access the growing number of sites and content. All this for the cost of a local phone call. Don’t forget that as advised in the last newsletter this current newsletter will also be published in PDF format and can be viewed on the SOPAC intranet using your favourite web browser with Adobe Acrobat.

Prakash Narayan, from Fiji, who is currently undertaking remote sensing research at Universitaire Weiss, Strasbourg, France has provided an update to the list of web sites of interest to the GIS and Remote Sensing community. In addition, he has covered some basics of classification as well as another image processing tutorial. He will be keeping us posted with future updates.

Management Services Division, Forestry, has contributed several articles ranging from image analysis through database development to map production. But whatever the field, there is a common theme which is the building of a forest inventory containing accurate information which can be compared over time to assist planners, policy makers and decision makers. Correct decisions will result in preservation of the natural resources which will lead in turn to maintaining biodiversity, erosion control, improved water quality, disaster mitigation and preservation of the coastal zone.

The three monthly Fiji GIS/RS User group meetings of May, June and July are reported. The June and July meetings were both milestones with the farewell of Michel Larue (SOPAC) and Wolf Forstreuter (MSD-Forestry). They are both founding members and active participants of the user group and it was an appropriate time to review why the group had been formed, what the goals of the group were and whether those goals were being met. The answers respectively were: the sharing of information and technology and the development of standards; the ability for relevant departments and organisations to implement and develop GIS/RS capacity in house while having access to technical support and data; and finally Yes! the goals were being met. It should again be noted that a GIS/RS user group was formed in Kiribati and modelled on the same guidelines as this group. The Kiribati group also meets on a monthly basis.

There is also much more and again we welcome contributions from national, regional and international users. Yes, you can reach us by Internet - see back page for the addresses!♍

NEWS

MAY MEETING

Fiji Land Information Support Centre, 2:30 pm Tuesday 14 May 1996.

UPDATES AND NEWS

Chang Surveyors

• Fiji Sugar Corporation is still undecided on implementing the GIS project.

Fiji Land Information Support Centre (FLIS)

• Three consultants from New Zealand evaluating the progress left last week.

• The census boundary capturing for the Bureau of Statistics (1996 boundary) is continuing.

• A hazard mapping pilot project is on the way, two coloured maps have been produced already and handed to parliament.

• Netware 4.0 training courses was held by Computec, 20 staff members attended

• SOPAC conducted MapInfo training for FLIS.

• Coloured info material is available about FLIS for public awareness.

Fiji Posts and Telecommunications Ltd (FPTL)

• The tender documents for the supply and commissioning of a GIS system have been provided to 21 interested parties.

Lukemine Enterprises

• USA must be testing the positioning the GPS satellites as last week between 12:00 and 12:50 local time the PDOP was absolutely out of range. Later everything was running fine.

Mineral Resources Department (MRD)

• 18 people attended a data management training course.

• Tests being conducted with SOPAC to establish a Web Server.

Management Services Division, Forestry Department (MSD)

• The Forest Type / Forest Function Maps arrived, 100 sheets per map, coloured off set printing. These maps cover also Vanua Levu in the new topographic map sheet partition.

• Digital data showing the road network and river system (including the smallest creeks) arrived on CD-ROM and will be available for every user.

• All plantation areas are mapped at 1:10,000 scale except two plantations in Viti Levu where a coordinate shift has to be carried out, which is still not clarified yet.

• MSD is working on the update of the Forest Type / Forest Function maps, these maps will be plotted again for all sheets where a noticeable change in plantation area occurred.

• MSD is able to plot maps with detailed road network and river system

• E-mail transfer of GPS rover data from Vanua Levu to MSD-forestry via SOPAC is working operational

• Osea Tuinivanua is co-investigator of the MOMS program. He managed that data of Fiji will be recorded in June and August this year. MOMS is a German sensor based in the Russian permanent space station providing 4.5 m data in panchromatic mode and 14 m data in multispectral mode.

• Josua Wakolo is attending a 10 weeks training course in Japan on remote sensing. Japan is providing this course to assist the actual users of space borne data.

• MSD is asking about status of data sharing

Native Lands Trust Board (NLTB)

• the data translation is in progress, NLTB is now working testing MapInfo.

Public Works Department (PWD)

• PWD is investigating the ownership of sewage pump stations. The stations have been GPS surveyed with the help of Forestry and others. PWD is now investigating the accuracy of hand held GPS rovers.

• one staff member has been sent to a MapInfo course to learn accurately digitising.

South Pacific Applied Geoscience Commission (SOPAC)

• Steve Solomon from Canadian Geological Survey who replaced Don Forbes at SOPAC was introduced and announced that the Suva vulnerability study has progressed to the point where the data collection is nearly complete on the coastal zone along the Suva waterfront. Data collection involved surveying elevations and mapping coastal types and attributes. Most of the data has been input into MapInfo GIS. The analysis phase will start in the next few weeks.

• SOPAC completed the a one week MapInfo training workshop for 20 participants from the government sectors in Fiji where FLIS was the administrator. A further training workshop will be conducted for 15-20 participants in Tarawa, Kiribati, in June. Again, a training CD will be optionally provided to each government department in addition to course notes provided to all participants. The CD will contain relevant datasets from Kiribati provided by both SOPAC and Kiribati government 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.

• Work on the Environmental Information System at DOE is progressing on schedule and the network is operational.

University of the South Pacific (USP)

• Next semester an advanced GIS course will be offered.

• Progress is being made towards the GIS Certificate Course which should be available next year.

World Wildlife Foundation (WWF)

• No developments or planned implementation of GIS.

PRESENTATIONS

SmallWorld - Steven Robertson (SmallWorld software)

SmallWorld is a UK based company which started in Cambridge in 1988 following an in-depth market survey. There are now 325 installations word wide with some 3,000 licenses. Since 1994 the company has an office in New Zealand. The headquarters for the South Pacific Island Countries is in Melbourne.

The software is primarily targeted at utilities (water, electrical, gas, telecomms) due to its networking capabilities and asset management features. The software is running under Windows NT, before it was written for UNIX. The package costs about $AUS 10,000. The program has a in-built vector to raster conversion and vice versa.

New Technologies for Teaching GIS - Franck Martin, SOPAC

The use of screen capture software which allows voice overlay was used for the recent MapInfo course conducted by SOPAC and administered by FLIS. This software enabled a series of tutorials to be recorded to disc files for subsequent playback. The files were then transferred to a CD together with baseline data, SOPAC Knowledge Base and MapInfo's own tutorial. The Knowledge Base is an Access database of questions and answers from the MapInfo-I news list and is now in excess of 3 MB in size. Solutions can be searched by subject. There was interest by several organisations who requested copies of the CD.

FLIS Network Upgrade & Tests - Mark Williams, FLIS

The problems associated with network growth were detailed and the need for network managers to have access to appropriate measuring equipment to ensure that the heath of their networks is maintained. Problems associated with total cables lengths being in excess of the recommended 185 metre maximum were identifies with two areas at 212 metres. The solution was to break these segments with a router or bridge.

FLIS is migrating from 3.11 to 4.1 and an upgrade strategy is in place.

Digital River System and Road Network of 1:50,000 Maps of Fiji new Map Series available at MSD, Forestry Department - Wolf Forstreuter

Wolf explained the digital infrastructure data available at MSD-Forestry. The Lands Department provided two sets of transparencies showing: a) the creeks and rivers, b) the road network, villages, village names, road names and river names. These transparencies have been scanned in Germany employing a high resolution scanner. For Vanua Levu the transparencies were only available in the old topographic map series coverage. These transparencies have been cut and

■ *by Franck Martin, SOPAC, E-mail: franck@sopac.org.fj*

WWW & GIS

– a case study: SOPAC Services –

Every day we read about the benefits of Internet and the World Wide Web (WWW). In our GIS community, someone may wonder how it could improve their work, and most important what is available now and at what cost.

SOPAC is deeply involved in the promotion and development capabilities in the geosciences in the Pacific Island Countries and we use GIS and remote sensing as well as new communication technologies to provide information about the Pacific. Part of these new technologies is the installation of a WWW server at SOPAC headquarters in Suva. This WWW server was designed to provide information first to SOPAC staff, secondly to other geologists and scientists, thirdly to the people of the Pacific, and finally to the public.

First: information for SOPAC staff

Information at SOPAC is in different formats. There are reports, maps and databases. Databases are developed under MS-Access. For one who knows MS-Access or other database software, it is cumbersome to load a 5Mb software application plus a 5Mb database in your computer to just require a simple phone number. Fortunately the WWW is here to help us. Microsoft Internet Information Server (IIS) has a built-in interface to request data via Open Database Connectivreassembled to the new sheet coverage before scanning. Now all infrastructure data is available in digital form related to the new map sheet coverage. Wolf explained that it is difficult to use the high resolution data set because of the file size which creates difficulties for the hardware installed at MSD-Forestry or Lands Department. However, MSD provided a way to resemble the files to a resolution easy to handle and accurate enough to be used for map printing. he also demonstrated maps plotted at MSD-Forestry with the infrastructure. The Lands Department will use the infrastructure data sets.

FLIS-GIS Upgrade New Features - Anselm Haanen, FLIS

The new Intergraph MGE system for CCMS was detailed and the provision of increased user access to the topographic database outlined.

Investigations underway with Intergraph VistaMap as a front end to Intergraph MGE.

The improved set of tools with the new Intergraph MGE was detailed as well as an enhanced MGE to MapInfo translator.

The usual problems of dependant upgrades was outlined and in the case of FLIS there have been the anticipated teething problems with migrating the GIS, backend database (Oracle 6 to 7) and network server (Netware 3.11 to 4.1) at the same time. However, the systems are now fully operational.

DISCUSSION

• Kevin McConnell (**Lukemine Enterprises**) advised on a project which had checked the location of 200 pumping stations and how while most were very close to FLIS data, some were several tens of metres out. Field work is needed to check these fixed installations and a system for revising the digital data will be implemented.

• **USP** requested feedback on what was the most popular GIS/Desktop Mapping application in use in Fiji and was advised by participants that the common standard was MapInfo. **SOPAC** stated that they had been quoted USD 43,000 for ArcInfo for NT which did not favour any promotion for this product.

JUNE MEETING

Management Services Division, Forestry Department, 2:00 pm Tuesday 4 June 1996

UPDATES AND NEWS

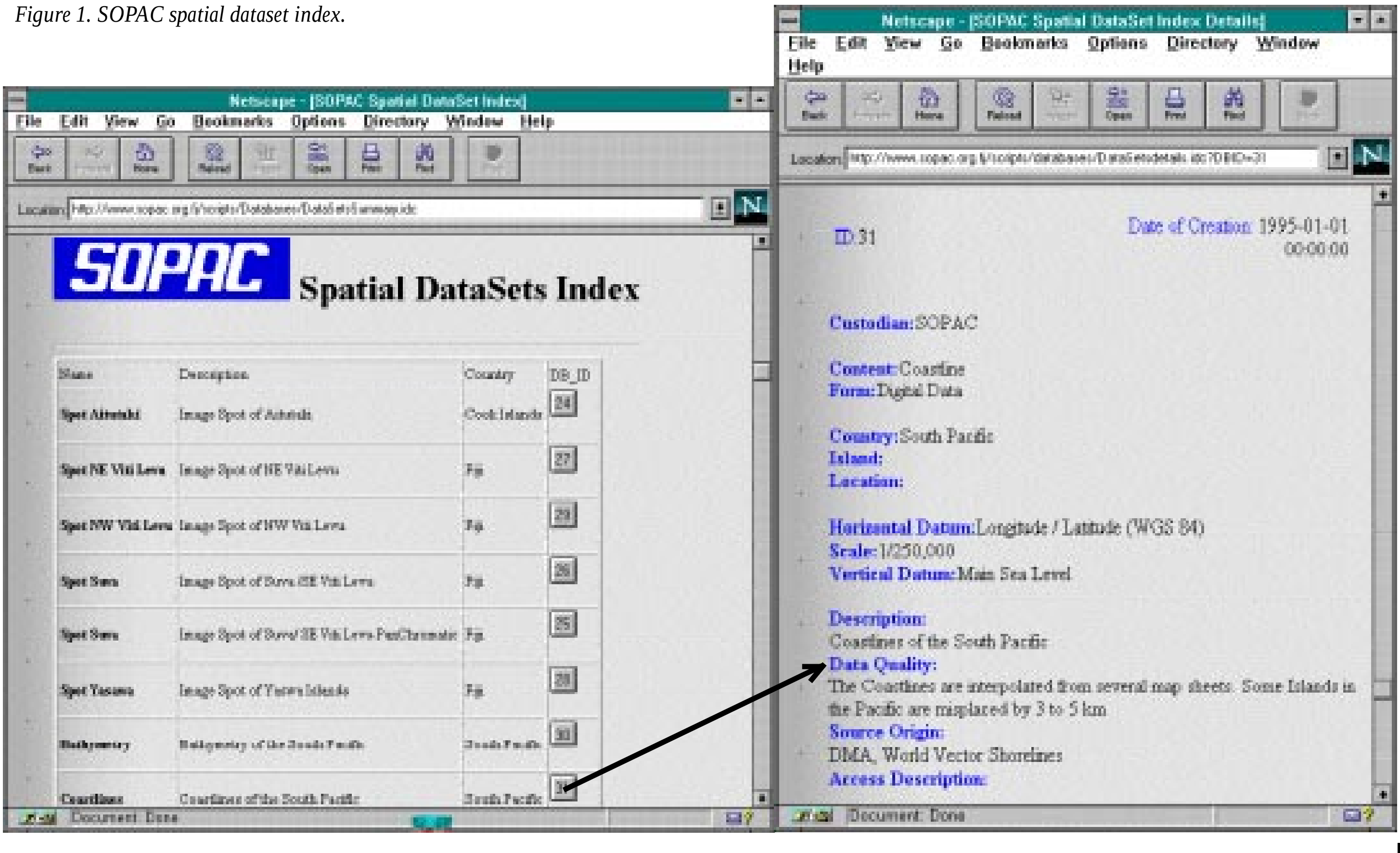
Osea Tuinivanua highlighted during his welcome that the European Union is the largest donor to forestry. Besides the plantation mapping project which is ending now, the EU finances the Forestry Management School which will be established in Colo-i-Suva.

ity (ODBC) to any kind of database and to display it in Hypertext Mark-up Language (HTML). HTML is the format read by WWW browsers such as Netscape or Internet Explorer. These browsers are simple and fast as they are just "viewers" of data. Another advantage is their availability on a wide range of platforms such as PC, Macintosh, Unix.… Your database developments suddenly reach a wider audience. For instance, SOPAC has a contacts database of people known by SOPAC who receive information from us, such as member country representatives, donors, scientists. To obtain the phone number or e-mail address of one of these persons takes several minutes with MS-Access but using Netscape, the whole operation is completed in less than 1 minute.

Second: Scientific information for the scientific community

Our geologists and coastal scientists are producing more than 40 technical reports every year, highlighting the geology and survey work in the South Pacific. These reports are freely available in SOPAC but you need to visit our premises to see it or request for a hard copy. We are currently converting these reports to Adobe Portable Document Format (PDF). This format saves the document com-

Figure 1. SOPAC spatial dataset index.



GIS will provide sub centimetre accuracy..

Chang Surveyors

Their project was presented and the need for a GIS explained. However, there are still some financial problems to purchase a system.

Fiji Land Information Support Centre (FLIS)

- Three consultants from DOSLI visited FLIS for three weeks for consolidation and stabilisation of operational systems.
- CCMS continues on extracting metric cadastral sheets and should be completed soon.
- topographical data base has been established with three staff working on the verification and cleaning of digital topo data sent from NZ.
- Two NLC files on DXF format had been successfully translated by FLIS to DGN format
- the hazard/earthquake pilot project is currently in progress.
- cadastral data transfer from FLIS to NLTB for ALTA review exercise is completed

Lukemine Enterprises

new GIS and GPS equipment will arrive at his company by end of June. This new generation of GIS will provide sub centimetre accuracy..

Mineral Resources Department (MRD)

- MRD has now a GTM package for mining control.
- the Internet connection to SOPAC is fully installed.

Management Services Division, Forestry Department (MSD)

- The EU funded plantation is completed. 71 maps are plotted at 1:10,000 scale. These maps were also imported to the Forest Cover / Forest Function maps to update the plantation area. Plantation image maps were produced at 1:50,000 scale.
- the transformation problem for two plantations in Viti Levu is solved by employing GCPs collected by GPS survey and ARC-INFO transformation modules
- Another SPOT scene is ordered which covers the north of Viti Levu
- Digital data capture by stereo-mapping is now concentrating on logging areas after completing plantation areas
- a consulting team from NZ is looking for the potential to privatise Fiji's hardwood plantations

South Pacific Applied Geoscience Commission (SOPAC)

- explained problems converting data from UTM to FMG. There will be a note in the next GIS & Remote Sensing newsletter.
- Franck Martin will be conducting a MapInfo workshop in Tarawa, Kiribati during the week commencing 17 June. The audience will be staff from government departments. A GIS & Remote Sensing User group will be formed and regular monthly meetings recommended. The aims of the group and the structure of meetings will be modelled on the Fiji group. A report on the outcome will be presented at the next meeting.
- The Suva Vulnerability Study is continuing and a report will be presented at the next meeting.

PRESENTATIONS

Overview on the EU Funded Forest Mapping Project, Wolf Forstreuter, MSD-Forestry

The purpose of the plantation mapping project was not only to carry out a the mapping at 1:10,000 scale, but to enable MSD to do the mapping and to integrate the mapping in the forest monitoring system. Wolf explained that this is necessary because a change of plantation area induces a change of natural forest cover. He also demonstrated the limits of GPS survey in forest environment. GPS was supposed to be used for mapping all plantation boundaries, however, it was partly replaced by stereo-mapping due to low accessibility of positioning satellites in forested valleys. Wolf also highlighted the need for satellite data for monitoring the development of the plantations. A detailed article will be published in the next GIS and Remote Sensing Newsletter.

Plantation Image Maps, Asesela Wata, MSD-Forestry

Asesela Wata explained the way to produce satellite images showing the forest canopy and the plantation boundaries at a scale of 1:50,000. Subsets covering the plantation area have to be cut out of georeferenced satellite images. Knowing the location and age of plantation sub-areas (compartments and stands) it is possible to carry

pressed with all its settings allowing anyone to view and print the document without altering its presentation. At the same time we have converted GIS catalogues from different organisations as well as the regular Fiji GIS and Remote Sensing Newsletters. Each document takes about 10 minutes to download on a 14.400 kbps line.

It is also interesting to browse through the data sets available and retrieve information such as: data type, custodian, accuracy, availability, updates, location… This is done through a link to the Spatial DataSet Index database developed by SOPAC for the Department of Environment (see Figure 1, previous page).

SOPAC has purchased some SPOT images. Someone may wish to have a quick look at these images before planning any work. This is already available and you can request this information by pointing to a location on a map. This creates a small picture of the SPOT image giving enough detail for you to consider the image worthwhile (see Figure 2, facing page).

Third: PEACESAT to provide information to the PACIFIC

PEACESAT is a network of Satellite Stations implemented in many Pacific Islands Countries. In addition to voice, these stations allow computers to exchange data. Therefore with a simple configuration, anyone using PEACESAT can access the SOPAC PEACESAT terminal and from there browse our WWW server.

Last: Information FOR the public

If you own a computer with a modem, you can freely connect to our WWW server by dialling 381023 and providing the username **meredith** with the password **123xyz**. Your computer must have TCP/IP PPP software with PAP authentication. For example, this is built-in to Windows 95 and Windows NT. You set your gateway as 202.52.1.155 and the DNS as 202.62.0.129, and you can connect to the URL: http://www.sopac.org.fj/. Please contact us if you need more information. The only cost is a normal phone call to this number (381023). Of course you are limited to browsing the local resources but it will take you time to visit everything and the number of WWW servers connected to our Intranet hub is growing.

And much more...

If you want to be kept updated about the GIS/RS community of the South Pacific, you can subscribe to the mailing list: GIS-PACnet@sopac.org.fj by sending a mail containing your e-mail address to GIS-PACnet@sopac.org.fj. ♍

out an object specific contrast enhancement. Then the plantation boundaries are overlaid onto the image. Asesela demonstrated that it is possible to show with such an product sub-areas of a plantation in which:

• Mahogany dominates the canopy,

• the natural forest dominates the canopy,

• the natural forest cover is still present, but dying due to poisoning.

Further investigations will enable MSD to separate different plantation species. Asesela Wata explained that plantation image maps cannot replace a 1:10,000 mapping, but it is a management tool for monitoring forest change and development. A more detailed article will be presented in the next GIS and Remote Sensing Newsletter.

Results of Forest Stratification Employing Digital Satellite Data, Osea Tuinivanua, MSD-Forestry

Stratification of Fiji's natural forests into forest species classes is necessary for better forest management. The availability of digital satellite data has cost-effectively enhanced the approach. By applying Landsat TM data, using appropriate image processing software (ERDAS) with local knowledge and in local situation preliminary results have been obtained. Using the Navua River Catchment (103,000) as a test site, approximately five tree species association have been classified. Field validation is continuing to authenticate these findings. This is quite a new development in the country as Fiji is solely relying on aerial photographs in the past. Digital satellite data will be readily available in the future and will become cheaper too.

Map Production with ARC-INFO, Velemani LatiLevu, MSD-Forestry

ARC-INFO software was already available at MSD, when the plantation mapping project started. It provides raster vector conversion and vice versa and can be easily linked to a dBASE data bank. The spatial plantation data is stored in ARC-INFO. Velemani explained the different data input which was done by stereo-mapping, digitising and GPS survey. The link to the relational plantation data bank updates the actual stocked area. The connected plotter allowed the production of more than 70 maps on transparencies from dyeline copies can be produced to low cost. An article will be included in the next GIS and Remote Sensing Newsletter.

Forestry Application of MapInfo, Owen Springford, Consultant, MSD-Forestry

Owen Springford is involved in the evaluation of Fiji's hardwood plantations. He found the spatial data resource needed at MSD-Forestry. MapInfo which is installed on his laptop computer has not the technical potential of ARC-INFO, but he was able to utilise all spatial data within a short time and without any transformation software. He also was able to take his laptop containing the spatial and non-spatial data about the plantations into the field for verification.

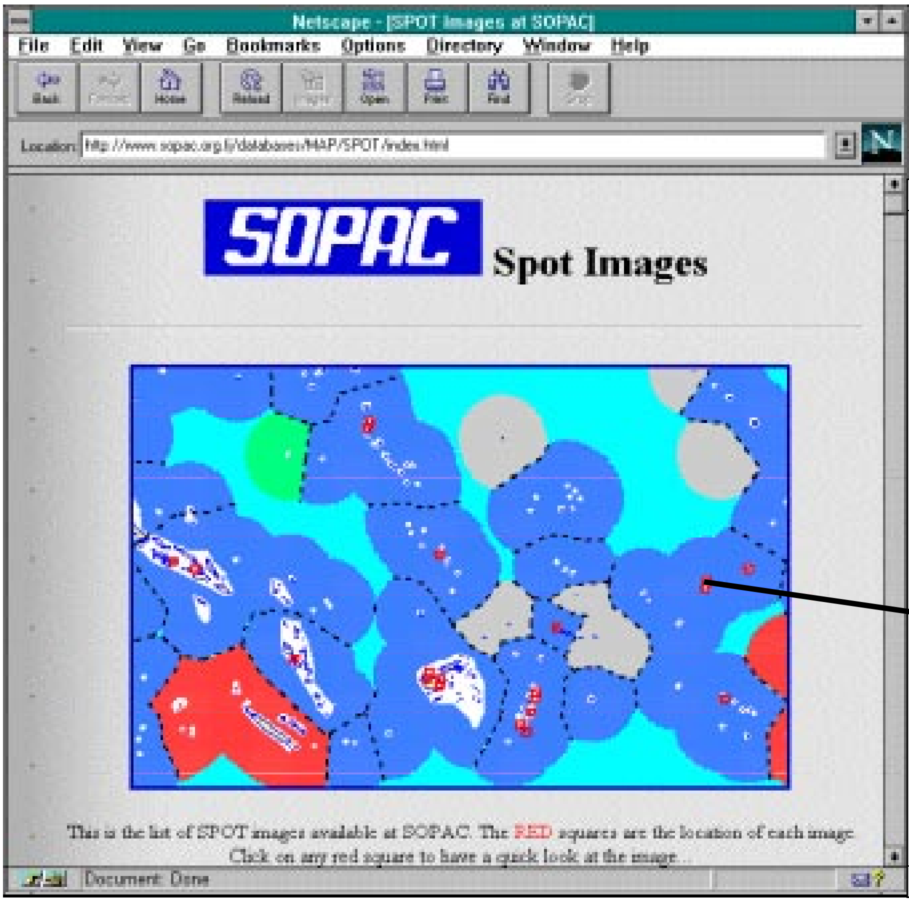
Purpose of Forest Monitoring, History + Discussion, Wolf Forstreuter, MSD-Forestry

Wolf gave a review of the GIS and Remote Sensing User's group history. This meeting started in Forestry about five years ago. With the establishment of FLIS the meeting grew and became very regular. During the years the content changed. In the beginning the information about updates dominated the meeting later presentations about special application or new technology. The meeting became an important information platform and Fiji is one of the few countries where people agreed on a common data format (DXF) and this is because staff on technical level have the mandate to meet regularly. For the future, SOPAC will become an important role because a regional organisation with the mandate for GIS and Remote Sensing can provide technical expertise required by national organisations. Wolf's job was also to introduce satellite Remote Sensing to Forestry. This specially required by Forestry because Forestry Departments in tropical countries have to monitor the change of forest cover and digital satellite images are the appropriate information. In the field of Remote Sensing the meeting still has to forward some ideas. Data sharing between Government organisation must be addressed to the satellite selling companies. The idea of a transportable ground receiving station must be discussed on decision maker level and then between the South Pacific Island Countries.

DISCUSSION

The question was raised why compartment boundaries within a plantation do not follow the mataqali boundaries, because this would avoid much problems during the harvesting of the timber later. At present the silvicultural management units are not linked to the ownership boundaries which will create discussion on a later stage.

MSD answered that it is already a technical problem to establish the plantation boundaries along the mataqali boundaries. To mark mataqali



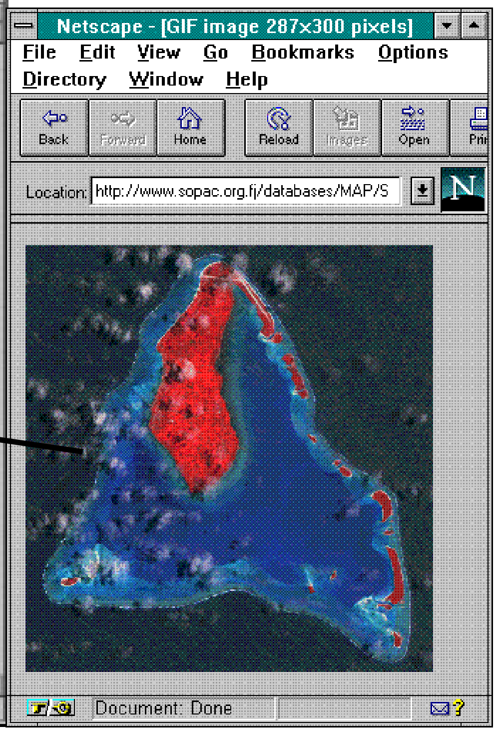


Figure 2. SOPAC SPOT Image search toolkit.

boundaries within a plantation cannot be mandate of a forestry division. MSD is waiting for the digital boundaries provided by NLTB via FLIS.

The question was raised which type of poison is used for chemical thinning.

MSD answered that Forestry was using arsenic poison and not the type employed in Vietnam by USA.

The subject of standards for exchange of data was raised and it was agreed that new standards are available in Australia which will better serve the needs of users and overcome the restrictions of DXF. The chairman suggested that this become a subject or theme for the next meeting.

The discussion of having a spatial data catalogue for every organisation ended with following statements:

• An Intranet/Internet Web site is the most effective.

• The catalogues should updated as normal text documents without standard format for the time being.

• The catalogues should be updated as soon as possible and stored at both FLIS and SOPAC.

• SOPAC will set up a home page on Intranet/Internet for remote access.

JULY MEETING

South Pacific Applied Geoscience Commission, 2:30 pm Tuesday 9 July 1996

UPDATES AND NEWS

Fiji Land Information Support Centre (FLIS)

Stage 1 Programme

• Extraction of all metric cadastral sheets completed.

• 1:1000,1:5000,1:10000 scales

• Data verification and cleansing continue on several existing operational systems like VKB and Titles Journal.

• Tests were conducted on cables/file servers in relation to access response time and connectivity. As a result Cables and antenna on all FLIS systems have been repaired or changed due to corrosion.

• Policy on Data Sharing between Government agencies had been endorsed by FLIC and a seminar is to be conducted on this policy before implementation.

Stage 2 Programme

• Cleaning/verification of digital topo data is progress. Digital contour data is now available.

Projects

• Hazard/Earthquake Pilot continues

• NLC Pilot Project is in progress

• Draft-Scooping document for Natural Resource Pilot Project completed.

• Extraction of Bureau of Statistics maps will commence tomorrow (10/7/96) and the final batch of the 1996 boundaries have been received and digitising in progress.

Training

• Four officers from FLIC member agencies have been nominated to attend the three months GIS training in Australia towards the end of this year, 1996. (PWD, NLTB, DTCP, Environment)

• 28 officers from FLIC member agencies sat their papers at the USP during the month of June and are still awaiting results.

■ *by Prakash Narayan, Cité Universitaire WEISS C120, 7 Quai du Bruckhof, 67089 Strasbourg, France*

A Practical Approach to Image Processing in Remote Sensing

Histogram, Transfer function, Palette, Composite colour, Image raster-vector vector-raster, Superpostion, Geometric rectification, Digitial Elevation Model(DEM).

Histogram

The histogram is a very important tool for image processing applications. It is a graphical representation of the distribution of shades of colour values used or in another words a visual representation showing the number of pixels belonging to each of the colour values in an image. With the help of the histogram we are able to see which intervals of colour values appear most in an image. The interest to see this interval is to determine whether this interval is a narrow or a wide one. If the interval is a narrow one then it means only a very limited numbers of colour values are used from among all those colour values available.

The humain eye can not differenicate the changing of very close colours therefore maximum information from an image is not revealed if the interval is a narrow one. This narrow interval of colour values are streched to include values of all the colour values available. This transformation enables the humain eye to differenciate better the changing of colours which leads to a better visual representation of the image.

Transfer function

After having visualized the histogram of an image, it is then to determine if the interval of color values used is a narrow or a wide one. If the interval is a narrow one, it is concluded that there is a poor contrast in the image. The contrast is the variation of the shades of colours in relation to one another. The lower and upper limits of this interval are determined from the histogram. A transfer function is then applied within this interval. Several types of transfer functions are available in an image processing software such as linear, equipopulation, logarithms, constant and point transfer functions. The new look up table is produced starting from the lower limit to the upper limit of the chosen interval of the histogram. The colour values outside this interval are attributed the value zero or any other desired value.

Publicity/Awareness Programme

• FLIS news Edition 14 has been completed and now ready for distribution.

• FLIS newly designed brochure are currently being distributed.

• The Permanent Secretaries meeting was hosted by FLIS. FLIS Support Centre made a presentation on the FLIS Programme and also organised site visits around existing operational projects after the meeting.

Housing Authority

• Although the first time at these meetings this organisation was very interested in development in GIS and in particular standards which have been developed and adopted in Fiji. Future participation is expected and it was noted that there has been involvement with PWD, FEA, Telecom.

Management Services Division, Forestry Department (MSD)

Completion of Wolf Forstreuter's EU funded project on all hardwood plantation

The following targets have been met:

Data capture - based map 1:1000 and scheme plan

• Digital re-mapping projected to FMG. Establishment of spatial data base link to:

• dBASE inventory plantation data bank

• Erdas raster GIS (1:50000) scale)

Production of Maps

Updates of Arc/Info System - Correction of Baravi plantation:

Field visits using GPS - for locations of GCPs

GPS data - Arc/info for co-ordinate transformation

Update existing BRV plantation map

Update of Forest Cover forest function - 1:50000

GIS Remote Sensing

Update forest cover forest function map - 028 Lands Department Map.

Information overlay district boundary with forest cover forest function.

Area statistics calculation.

Update of natural forest data bank.

Process digital river and road network

An example of vector based information converted to raster TIFF format, initially extracted from the original transparencies from Lands Department and scanned for production of digital reproduction of transparencies then converted and stored in compressed file format for space efficiency

Map Distribution - Forest cover forest function map - distributed to some organisations, including NLTB, Director of Lands, Koronovia Land Section, DFO N, S, W

Another SPOT scene, covering North of Viti Levu has just arrived.

South Pacific Applied Geoscience Commission (SOPAC)

• Intranet web services established and tests clearly demonstrate that this media is the most effective method for distribution and publishing of GIS information for corporate users, national and international users.

• The Kiribati GIS & Remote Sensing User Group initiated following the MapInfo workshop conducted by SOPAC in Tarawa during June 1996.

• The Suva Vulnerability Study is nearing completion and brief report to be presented at this meeting.

• Michel Larue's final meeting.

Palette

The palette defines the number of shades of colour values available to display an image file. For 8 bit visualization 256 shades of colours are possible (2^8 =256), for 16 bit visualization 65536 shades of colours are possible (2^16= 65536). The more shades of colours available the better it is to differenicate between shades of colours. To have a visual representation of colours, a combination of Red, Blue and Green (RBG) colour components are attributed to each colour values.

Composite colour

The notion of the three fondamental colours Red, Blue and Green is utilised. These three basic colours are affected to one of the image bands. It is evident that when using this technique only three bands at a time can be used to display an image. For those images having more than three bands, a transformation is performed to produce only three new bands using information from all of the bands of the image.

An example using a SPOT image : band XS1 is affected to colour Blue, band XS2 is affected to colour Green and band XS3 is affected to colour Red.

Image raster-vector, vector-raster

An image is a matrix of pixel numerical values. Each matrix coordinates has a numerical value attributed to it. This is a representation of the whole image and is refered to as a raster image file.

When only a limited amount of information is extracted from an image, it becomes evident that fewer stocking space is required. Thus if a matrix representation is used, there will be some coordinates that will not be used, a waste of stocking space.

So only for the coordinates for which the pixels are used, the pixel's numerical values are stocked in a file which is referred to as a vector image file. It is possible to superpose a vector file onto a raster file or vice versa using the appropriate file conversion transformations.

Superpostion

This is the superpostion of two image files that contain two different types of information for the same image file.

An application example : Superpose a composite colour image file with an image file that contains only vegetation information of that image file.

To obtain the vegetation information, the NDVI is calculated using the band data values. A filtre is then passed to smooth out the contrast (ex. average filter). A specfic filter is then passed to find the contours that are supposed to contain only vegetation information. Using commands appropriate to the software been used the composite colour image is superposed onto the image containing only the vegetation information. We will have a composite colour image with the con-

University of the South Pacific (USP)

As announced in past meetings, USP will offer an advanced GIS course next semester, called GE305: Spatial Topics in Geography, Advanced GIS. Tentatively, it will be taught by Mele Rakai and/or Bruce Davis. The venue will be SSED, rooms S009 and S008. The times will be Monday 4:00 - 6:00 pm lecture. Tuesday 5:00 - 7:00 pm lab.

The times are to support working professionals as well as students. Alternate times may be available. It will be a hands-on course, with a full week to complete assignments usually. Please note that it should not be as high-pressure as GE204.

Topics include: Data quality and standards, integration of remote sensing data into GIS, use of GPS, advanced raster and advanced vector analysis, GIS database design and development, project design and development, and others. It is meant to be a follow-on to the introductory GE204 course.

Prerequisites: GE204 (Introductory GIS) or equivalent. Some experience with GIS software strongly recommended. Second year students successfully completing GE204 are eligible.

For further information, please contact Bruce Davis (davis_b@usp.ac.fj) or George Saemane (saemane_g@usp.ac.fj). For registration information, please contact the Registrar's Office at USP.

Keresi Fonmanu (Student Melbourne University)

Keresi described her project on NLC boundaries and advised that she has been using IDRISI, Latitude and Sage to analyse the data. She strongly recommended that students who are considering undertaking post graduate studies in Australia should undertake the full range of available GIS courses at USP before studying overseas as the standard is extremely high.

PRESENTATIONS

New tools for Metadata catalogues. Anslem Haanen, FLIS

The importance of metadata was stressed which can make datasets more accessible, avoid duplication, increase efficiency. Metadata is a database of data and an essential tool for an organisation handling multiple GIS data sets. World-wide standards are being developed and a presentation was made of the ANZLIC system which addresses privacy where this has become an emerging concern. ANZLIC has proposed a minimum number of core elements via a national strategy which trades off the minimum number of elements and the needs of the users.

It was noted that Microsoft Access has been selected by ANZLIC as the database of choice for developing and collecting the Australian and New Zealand data for subsequent publishing of the national or regional metadata catalogue.

SOPAC Intranet/Internet Web Server as an access tool for Metadata catalogues. Franck Martin, SOPAC

The dramatic increase in acceptance of Web servers as a method of distributing and publishing information world-wide has led many companies to adopt Web servers and browsers as a means of accessing data at the corporate, national and international level. The areas of GIS and Remote Sensing have been traditional users of the Internet for publishing their data. Two examples are the Canadian Geological Survey and the satellite image provider, SPOT. SOPAC has developed a Web Server for use within the organisation as well as other users in Fiji via an Intranet. MapInfo is shortly releasing an upgrade to MapInfo Pro (4.1) as well as MapInfo Pro Server which will allow clients running popular Browsers such as Netscape and Internet Explorer to query Web servers with GIS functionally provided by MapInfo Pro Server which passes CGI or API requests to a MapInfo session which accesses databases. The promise of this new technology was demonstrated via the Intranet.

Kiribati GIS & Remote Sensing User Group. Franck Martin, SOPAC

Franck Martin reported on MapInfo workshop in Tarawa, Kiribati during the week commencing 17 June conducted by SOPAC. The audience was staff from government departments. A GIS & Remote Sensing User group was formed and the first of regular monthly meetings held. The aims of the group and the structure of meetings were modelled on the Fiji group. A newsletter was produced which should serve as a record of the meetings as well as publicising the activities of the group within Kiribati. In addition, training was provided on newsletter layout and design using Microsoft Publisher.

A Coastal GIS for Assessing Vulnerability to Rising Sea Level. Jens Kruger, SOPAC

This project is nearing completion with all survey data collected and stored in a GIS. Complex calculations have been applied to determine possibility of damage through sea encroachment and tsunamis using past data for tide levels, wind velocity and directions as well as the topography of the reef. The outputs of the calculations can be overlaid on coastal areas with high vulnerability and varying height above sea level to determine a vulnerability index for appropriate areas. The final results will be presented to Department of Environment to enable them to assist in the development of the Suva peninsular and enable steps to be taken to mitigate disasters.

Forest cover change in Western Samoa using MapInfo. Leslie Allinson, SOPAC

In 1989 a GIS of Western Samoa was created in Arc/Info under an ADB funded land use project for the government departments responsible for land survey, agriculture and forestry. The data in the GIS was nearly lost due to hard drive failure as well as a tropical cyclone which ruined the computer system. However, the data was recovered and taken to the Australian National University for the background in a land use publication and later the data returned to Samoa. However, the usefulness of the data was severely limited due to it being in Arc/Info format and staff at the Department of Lands and Survey arranged for both spatial and attribute data to be translated into MapInfo at another Australian university. The data set was then converted to the Western Samoa Integrated Grid datum and the Department began adding new data which includes land parcels (Apia only at present), meteorological stations and rainfall data. This valuable data set also contains historical land cover from aerial surveys for 1954 and 1989 which shows a 19% loss (1,348 to 1,090 sq km) of forest cover in this period in a Savaii with a 32% loss (739 to 503 sq km) in Upolu where these islands have land areas of 1,695 and 1,130 sq km respectively. The purpose of the presentation was to demonstrate the ease with which data could be

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tours of the vegetation boundaries on top of this composite colour image. It is the composite colour image that is modified.

Geometric rectification :

A reference image is used to carry out a geometric rectification of an image. A reference image is an image that is supposed to be «correct», a map for an example.

Ground control points are chosen from the image to be rectificied with their corresponding points in the reference image. An image is rectified by using one of the rectifying methods proposed by the image processing software been used.

An example using the triangulation method: The control points are graphically chosen using the zooming facilities for finer point locations. The triangle points chosen are visualized to see that the triangle do not cross each other. More ground control points are added or removed as the need maybe. A polynom degree is chosen (degree 1,2 or 3) for which the residue is examined.

Ground control points with a large residue are also removed. Triangles are constructed before the actual rectification process is carried out by using the appropriate software modules.

Digitial Elevation Model (DEM)

DEM values are obtained from two images of the same scene taken from two different angles using stereoscopic. The DEM is used to represent an image in a 3 dimension representation. The DEM value file is used in conjunction with an image file to produce the 3 dimensional representation. ♍

analysed and displayed in MapInfo.

Overview of GIS and Remote Sensing Program at SOPAC. 1992-1996. Michel Larue, SOPAC

An overview of the GIS and Remote Sensing Program at SOPAC showed that this relatively new technology has now evolved into a mature product and is widely accepted as a tool for a host of applications, in particular land management and land cover monitoring. The GIS components of data entry, processing, storage and retrieval were outlined and examples given using bathymetry datasets. The applications required for these processes range from high end specialist UNIX tools through Arc / Info, ERDAS, ER Mapper and mid range entries such as AutoCAD, Microstation and MapInfo. The bundle selected by SOPAC as appropriate for the geology sector in the Pacific Island Countries is MapInfo, Surfer and IDRISI.

The entry stage has been typified by analogue to digital using scanners, raster to vector converters; use of digitising A0 and A3 tables with AutoCAD and MapInfo while the processing stage uses Surfer, Quicksurf (AutoCAD add-in) and Vertical Mapper (MapInfo add-in) for gridding and contouring, IDRISI, Adobe Photoshop and Corel Photopaint for image analysis. Specialist Visual Basic tools have been required for much of the offshore survey data. The storage phase uses networked file servers with high capacity hard drives, DAT backup as well a Exabyte tapes. CD-ROMs are used for general storage and distribution of the data while metadata catalogues. The holdings now include 2,400 MapInfo layers

The final stage is retrieval and all roads lead to the Intranet / Internet. It was noted that problems encountered included quality control, database design, GPS uncertainty and sustainability of data holdings.

The future lies in a regional organisation being responsible for co-ordinating the data acquisition, data holdings and method of publishing to reduce costs and increase efficiencies.

DISCUSSION

• Following proposal by FLIS, the group thanked Michel Larue for his GIS support during the past four years and it was noted that Michel was an active participant in these monthly meetings.

• General discussion on the future of Intranet services in Fiji.

• There was general consensus that feedback from FLIC would be invaluable for this meeting to determine whether the cooperation engendered by these meetings was providing positive results as perceived by policy makers.

■ *Prakash Narayan, Cité Universitaire WEISS C120, 7 Quai du Bruckhof, 67089 Strasbourg, France*

An Update of GIS & Remote Sensing Internet Sites

Remote Sensing / Geography Information Systems (RS / GIS) is a developing discipline therefore access to new information is very essential to keep abreast with the changes. It can be Software development, Modelling techniques, Imaging material and techniques, applications, new products or just simply curiosity. Large amount of these information is available on the Netscape or mosaic through Internet. Knowing where and what information is available really helps to reduce utilisation time.

1) **http://www.asprs.org/asprs**
2) **http://www.geomatics.com/rti**
3) **http://www.acsm-hqtrs.org/acsm**
4) **http://www.ersi.com**
5) **http://www.gisworld.com**
6) **http://www.bentley.com/**
7) **http://www.bluemarblegeo.com**
8) **http://www.thinkspace.com**
9) **http://www.tydac.com**
10) **http://www.alexandria.sdc.ucsb.edu/**
11) **http://ewse.pci.on.ca**
12) **http://www.nbs.gov/nbii/**
13) **http://www.gcmd.gsfc.nasa.gov**
14) **http://www.northwoodgeo.com**
15) **http://www.eosat.com**
16) **http://www.gislab.teale.ca.gov**
17) **http://www.urisa.org**
18) **http://world.std.com/~able**
19) **http://ogis.org**
20) **http://www.lib.unb.ca/GGE/**
21) **http://www.ccrs.emr.ca**
22) **http://www.stakart.no/isotc2111/**

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

SATELLITE NEWS

The satellite news will concentrate on three main topics, the EarthWatch Programme, the Indian Satellite and the MOMS programme. There is no news about SPOT, JERS-1 or Landsat data, the systems work normal. For Fiji, Landsat scenes are only available as historical images. The latest SPOT scene of Fiji arrived at MSD in July this year; the scene is nearly cloud free and covering the Monasavu area.

1. EarthWatch Programme

The EarthWatch Programme will set a new dimension in image data application in terms of availability, coverage and delivery. As reported in earlier newsletters, the company EarthWatch Incorporated was formed in January 1995 by merging two companies Ball Aerospace & Technologies Corp. And WorldView Imaging Corporation. Further, the Company has developed a range of worldwide strategic partnerships including Hitachi (Japan), Nuova Telespazio (Italy), CTA (USA), Datron Systems (USA), MacDonald Dettwiler (Canada). This group of companies cover satellite technology, downlink and data distribution experience as well as Remote Sensing and GIS knowledge. EarthWatch announced that they will build and launch their satellites at one-tenth the cost of competing satellite projects. This is likely to lead to price reductions for data.

The programme will deal two types of satellites the Early Bird and the Quick Bird. The Early Bird will be launched December 1996 and Quick Bird in late 1997. Both satellites have onboard storage capacity and will download the image data in either Alaska or Colorado where the company has build ground antennas. Early Bird is able to store 500 scenes per orbit, which is an improvement compared to existing satellites. Both satellites have each two sensors on board The satellite and sensor characteristics:

Early Bird

satellite characteristics:

orbit: sun-synchronous
accessible swath: ± 280 km
height: 470 km

panchromatic sensor:
scene coverage: 3 x 3 km
spatial resolution: 3 m
spectral coverage: 450 - 800 nm (panchromatic)

multispectral sensor:
scene coverage: 15 x 15 km
spatial resolution: 15 m
spectral bands: 500 - 590 nm (green)
610 - 680 nm (red)
790 - 890 nm (infrared)

Quick Bird:
satellite characteristics:
orbit: medium inclination
accessible swath: ± 360 km
height: 600 km

panchromatic sensor:
scene coverage: 27 x 27 km
spatial resolution: 1 m
spectral coverage: 450 - 900 nm (panchromatic)

multispectral sensor:
scene coverage: 27 x 27 km
spatial resolution: 4 m
spectral bands: 450 - 520 nm (blue)
520 - 600 nm (green)
610 - 680 nm (red)
790 - 900 nm (infrared)

The company will develop a system to send the data by Internet to the user. The user does not become the owner of the data, but leases it for the purpose of a project.

2. The Indian Satellite IRS-1C

The Indian Satellite IRS-1C is the only operational digital sensor providing high resolution data (5 m panchromatic data, 25 m multispectral). The data can now be received by the following ground receiving stations:

- Norman, Oklahoma (USA)
- Shadnagar (India)
- Neustrelitz (Germany)
- Johannesburg (South Africa)
- Alice Springs (Australia)
- Haloyama (Japan)
- Cotopazi (Ecuador)
- Bangkok (Thailand)

For areas not covered by these ground receiving stations like South Pacific, the satellite has a onboard tape to store images until passing a ground receiving station. IRC-1C has the same data format as Landsat TM.

Questions and data purchase can be addressed to:

EOSAT
4300 Forbes Boulevard,
Lanham, MD 20706
Fax: +1-301-552 3762

NRSA
Dept of Space, Govt. of India
Balanagar, Hyderabad 500 037
Andra Pradesh, India
Fax: +91-40-278 664, +91-40-278 648

3. The MOMS Programme

The MOMS-2P sensor is onboard the permanent Russian space station MIR. On 7 May 1996, the space shuttle PROGRESS carryiny MOMS sensor was connected to MIR. Data recording is postponed until October 1996. MOMS will record multispectral and panchromatic data from Fiji, because Osea Tuinivanua[1] is a co-investigator in the MOMS programme. ♍

[1] For further information contact: Osea Tuinivanua, Fax: +49-761-203 3701. He is head of MSD-Forestry

■ *by Wolf Forstreuter, MSD-Forestry*

Digital River System and Road Network available at MSD

Introduction

One target of Fiji's Natural Forest Inventory Project was the production of Forest Cover / Forest Function maps. During the planning process it was assumed that the infrastructure was available in digital form in Fiji, which was not the case. The first maps provided were not acceptable. After the visit of a GOPA representative to Fiji it was decided to present the revised maps in the new Lands Department maps sheet coverage. The only acceptable way was to scan the infrastructure from available information and combine this data digitally with the forest information. This was an additional and necessary step so that Fiji's requirements could be met. Fiji's Forestry Department wanted to benefit other Departments and asked for the digital data sent with the physical maps to Fiji. Both arrived, during the last weeks.

Data Source

The Lands Department provided copies of the original transparencies of the infrastructure[1] without additional costs besides material and overtime. These transparencies were scanned by a company in Bremen / Germany. In order to scan the road network and rivers for Vanua Levu the transparencies of the old map sheet series were cut and assembled to fit into the new map sheet series coverage.

The digital data of the scanned transparencies is available on CD-ROM at MSD. For every map sheet the CD-ROM contains a dedicated directory. Thirty-eight map sheets or directories are accessible (see Table 1).

For map sheets covering Viti Levu the users find in every directory a file containing the

Table 1. Directories available on CD-ROM containing digital map information.

L-26	L-27	L-28	L-29			
M-26	M-27	M-28	M-29			
N-26	N-27	N-28	N-29	N-32		
O-23	O-24	O-26	O-27	O-28	O-29	O-32
P-22	P-23	P-24	P-27			
Q-22	Q-23	Q-24	Q-25-26	Q-28	Q-29	
R-22	R-23	R-24				
S-21	S-22	S-23	S-24	S-25		

[1] this was possible in Fiji, it might be difficult in other countries!

scanned road network indicated by "**_S**" and the river system indicated by "**_B**"and a "**FCIF_**" file containing the ***F***orest ***C***over and ***I***nterpreted Forest ***F***unction map[2]. For most map sheets of Vanua Levu the road network and river system is combined in one file.

```
Directory M_28

FCIF_M28 TIF     1,922,156 08-02-96   8:05p
M28_B    TIF     3,864,132 06-10-95  10:14p
M28_S    TIF     4,420,762 02-02-96  10:04p
```

Figure 1. *Listing of one directory in this case for map sheet M28.*

From Compressed *.TIF to ERDAS *.GIS Files

MSD-Forestry is equipped with software such as ERDAS, ARC-INFO, MicroStation, ImageAlchemy that is able to read TIF format. However, there are different TIF formats, which was unknown to MSD. Further, the data format description was not provided. The format was analysed and the conversion was carried out at SOPAC by using ENDOBE PhotoShop software.

Then MSD-Forestry was able to convert normal TIF files to ERDAS GIS files. The file size created the next problem. The corresponding ERDAS GIS file for a 40 MB TIF file has about 350 MB! The solution was to work on a Magneto Optical Disk (MOD) which has 1.2 GB or 600 MB on each side[3]. ImageAlchemy and ARJ software were loaded on the MOD. Then a MS-DOS batch file was created containing for every compressed TIF file the following steps:

- decompression with ARJ software
- conversion from uncompressed TIF to ERDAS GIS by ImageAlchemy
- compression of ERDAS GIS by ARJ software
- deleting the TIF and the GIS files

These steps took about three to four hours for every file!

Compressing the Resolution and Geometric Correction

The created GIS files have 15,700 lines and 22,600 columns. The smallest linear elements which are the grid lines have a width of five pixels. In order to create manageable files a cluster of four by four pixels had to be converted to one pixel.

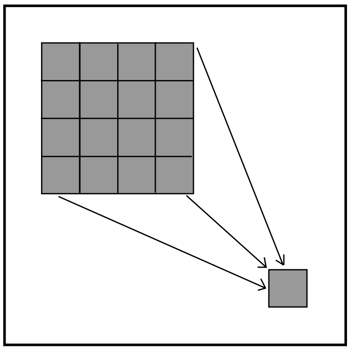

Figure 2. Aggregation of information, a matrix of 4 x 4 pixels were combined to one pixel by ERDAS module AGGIE. This decreases the information content, see Figure 7.

It was noted that the scanned transparencies have a slight distortion that prevents them from being copied directly to the Forest Cover / Forest Function information layer. More importantly these layers have to have the same pixel range as the forest cover / forest function layer. This has been archived by a geometric correction program forcing the four corners of every layer to fit.

To find the four corners of a map layer an interactive process is required where the operator identifies the X- and the Y-value by features visible in the form of roads and rivers in comparison with the physical maps. For each individual map sheet the four corners of the actual map content have to be transferred to the corner pixel of a matrix containing 4800 columns and 3600 lines (see Figure 3).

	new file co-ordinates		old file co-ordinates	
1)	1	1	871	129
2)	4800	1	5604	101
3)	4800	3600	5627	3645
4)	1	3600	895	3673

Figure 3. GCP file for geometric correction of the already resembled data set. The geometric correction ensures that the infrastructure fits exactly over the forest type information, however, performed like this it creates a further reduction of resolution.

Decreasing the Pixel Size of the Forest Cover Information

After the described geometric correction of the infrastructure files, it is necessary to adjust the pixel size of the forest cover information to be presented in the map. One pixel has to be converted into a matrix of 3 x 3 pixel, so that the forest information of one map sheet covered by 1600 columns and 1200 lines is transformed to a file of 4800 columns and 3600 lines. To carry out this transformation a geometric correction is employed again, but this time the process increases the file size for the forest information.

	new file co-ordinates		old file co-ordinates	
1)	1	1	1	1
2)	4800	1	1600	1
3)	4800	3600	1600	1200
4)	1	3600	1	1200

Figure 4. GCP file for file transformation, the process decreases the pixel size and increases the file size of the forest cover information.

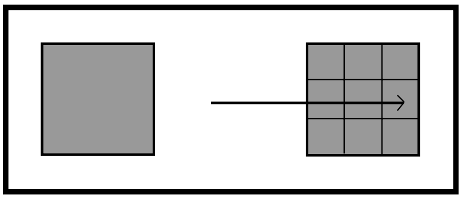

Figure 5. The file transformation process creates out of one pixel nine pixels storing the same thematic information.

After the process the files containing the infrastructure and the file containing the forest cover information have the same orientation and pixel

[2] The digital FCIF maps have been created at MSD as part of the forest inventory project.
[3] MSD-Forestry is using SONY MOD

size. For the first maps the pixel size was only reduced by factor four (one pixel was converted to four pixel). This required a resembling of the infrastructure producing numbers and letters difficult to read (see Figure 5)

Comparison of Resolution

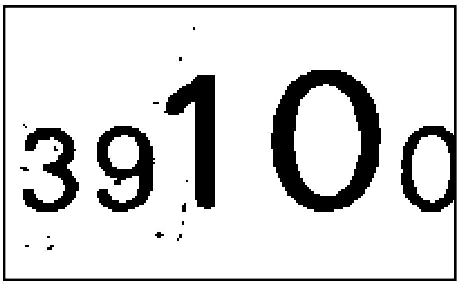

Figure 6. Upper left corner of map sheet O28 in the original data file of the scanned transparency.

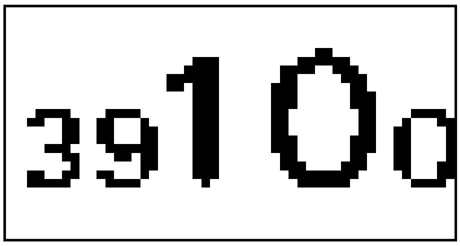

Figure 7. Upper left corner of map sheet O28 in the resembled data set, 4 x 4 pixels are condensed to one pixel.

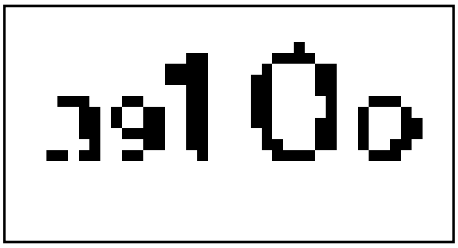

Figure 8. Upper left corner of map sheet O28 after geometric correction employing a further reduction of resolution by factor 3. This is no longer carried out, the pixel size of the forest cover information is decreased by factor three instead.

Conclusion

The time requirements are not listed in the article. For one map sheet showing the forest information combined with the river system and road network 22 hours computer time are necessary. Mainly the steps of aggregation and geometric correction are very time consuming. However, it is possible to carry out such a job in Fiji. Further, once the infrastructure files are converted, aggregated and geometrically corrected it is easy to overlay them on any existing map information. MSD-Forestry provides an excellent tool for map production. The infrastructure layer ready for overlay are available for seven map sheets and further processing is under way.♍

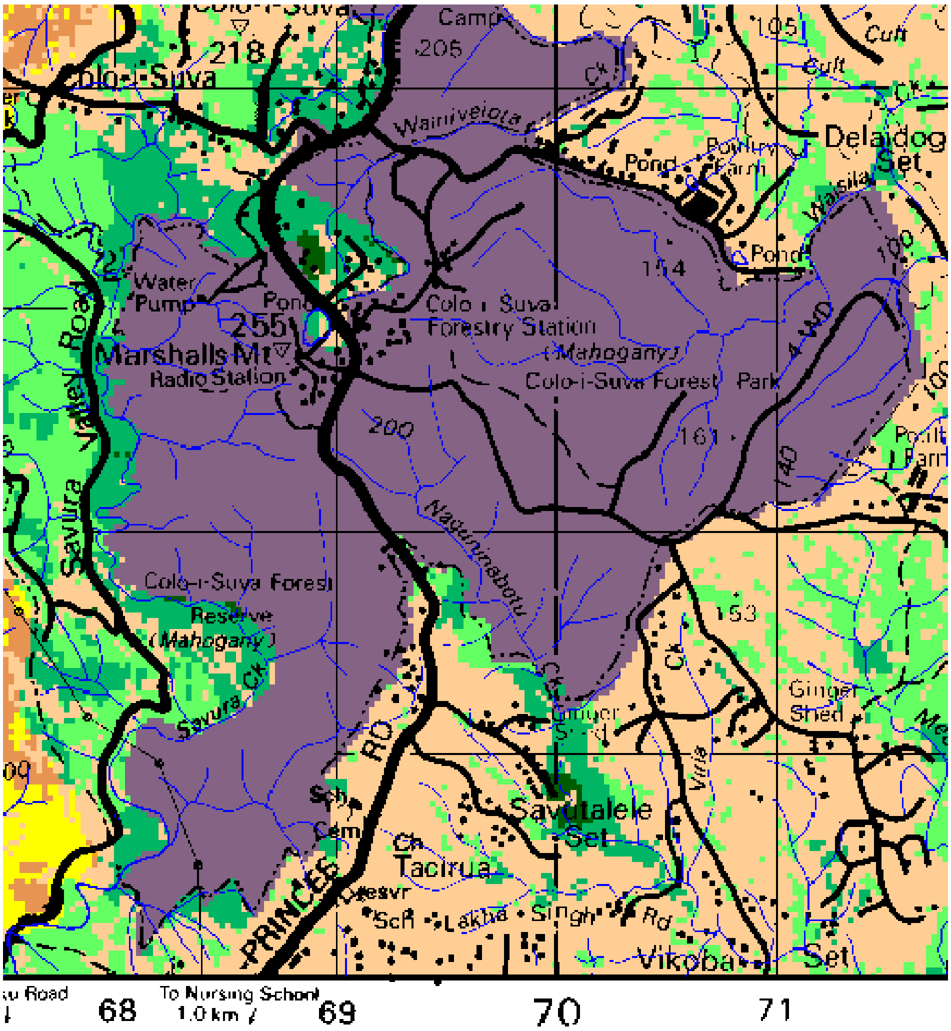

Figure 9. Subset of a digital Forest Type Forest Function map showing Colo-i-Suva Plantation after re-mapping. The infrastructure and numbers are clearly visible although the resolution is reduced by factor 5.

■ *Velemani Latulevu, MSD-Forestry*

Production of Plantation Maps with ARC-INFO

Introduction

Under EU funding all hardwood plantations in Fiji had to be re-mapped in order to link them to the forest monitoring system. The target was to establish a spatial data base which can be linked to ERDAS raster GIS (1:50,000 scale), to link it to the dBASE plantation data bank storing timber-related information and to plot transparencies to produce dyeline copies. For this activity MSD employed ARC-INFO because:

- the scale of 1:10,000 required a vector data based spatial data base
- ARC-INFO provides an ERDAS in-built vector to raster conversion
- ARC-INFO provides real raster to vector conversion
- ARC-INFO provides the link to dBASE which was difficult with MicroStation, a vector data based software also available at MSD

Knowing about the high time requirements of ARC-INFO because of its user unfriendliness all jobs are reduced to the minimum amount which has to be handled by ARC-INFO.

Results showed procedures used by MSD to carry out the mapping was standard operation for such a mapping purpose.

Converting Existing Maps

The Lands Department provided plots on transparency for plantations already mapped by them. However, these maps have no link to the forest monitoring system and no link to the plantation data bank either. The spatial data capture was based on conventional stereo-mapping which does not create a digital data base. These maps have been digitised with ARC-INFO[1] and are available in a digital data set. The conversion from Cassini to Fiji Map Grid (FMG) was carried out with Mike Poidevin's program, by using the surrounding map edges as Ground Control Points (GCPs). The time consuming part of the map production is the fine editing, such as adding compartment and stand number, species, road names etc. for all plantations where a mapping of unstocked areas was carried out this information was stored in a different layer and combined with the plantation boundaries by the ARC-INFO module UNION.

Converting Existing Maps of Unknown Projection

Two maps which were digitised were delivered without any coordinates. It was impossible to define the coordinate system and projection used for these maps. To transform these two maps to FMG, GCPs were collected and distributed proportionally over the plantation. These GCPs were then visited in the field with the GPS (Global Positioning System) and the satellite delivered position recorded. Employing these coordinates a data bank was established keeping for X, Y of the digitising table also the FMG of these GCPs. Then the ARC-INFO module TRANSFORM transferred the digitised spatial data into a coverage related to FMG.

Producing New Maps

No maps were available for plantations on Vanua Levu. At the beginning of the project it was planned to carry out a complete GPS survey recording the boundaries, main creeks and main roads. This was impossible due to time constrains and poor satellite reception in the valleys. Stereo-mapping of 1:50,000 aerial photographs was applied. The stereo-mapping was carried out in MSD using a ZEISS Visopret. The FMG position of all creeks, rivers, roads and of all ridges was recorded. The GPS survey later was only[2] used to identify the position of features not visible in the photographs. The data set captured by stereo-mapping and the data recorded by GPS were then pre-processed in MicroStation before converting to DXF and shifting into ARC-INFO.

Non-stocked areas were mapped with a Baush&Lomp Zoomtransferscope from 1:25,000 coloured photographs[3], by superimposing them on to the newly plotted 1:10,000 maps and drawing their boundaries into the maps for digitising.

Results and Future Investigations

72 maps were plotted on transparency paper. Of every map, three dyeline copies were produced and handed to the field staff, to help with managing the plantation. It will help to avoid further over-planting[4] and will provide exact area figures as payment base for all silvicultural activities.

Any additional change of area corrections can now be considered in a fast and cost effective way. It is important to note, that every further change will automatically change the area estimation at the 1:50,000 level, which means that every future conversion of natural forest to plantation will also update the data base of natural forest.

The data transfer from the raster data based GIS to ARC-INFO storing the spatial plantation data base was not performed, because in was not necessary at this stage. However, it was carried out on a trial basis in order to show the operationality. If there are no aerial photographs satellite images could be taken as a provisional data source. ARC-INFO allows the data link.

As a next step the plantation data bank stored in dBASE IV could be set on top of the spatial data base stored in ARC-INFO. Therefore ARC-View can be employed. ♍

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[1] this would have been also possible with MicroStation, but the system was occupied during this time and ARC-INFO was available.

[2] which was still sufficient to keep one survey crew busy!

[3] it was technically impossible to employ these aerial photographs for the stereo mapping.

[4] planting areas outside the plantation due to inaccurate maps

■ *Osea Tuinivanua, MSD-Forestry*

Improving the Understanding of Water Catchment Forest Cover with Thematic Mapper Data

Abstract

The exercise is a continuation of the application of TM data through additional image enhancement of spectral properties to exhibit the potential differentiation within the Navua water catchment forest cover. However the complexity and variability in the forest species composition remains. Secondly the ever present problems of cloud and haze. Spectral information with original raw TM bands was increased by deriving new bands. Additional bands from principal component and tasseled cap transformations improved the understanding of forest cover within the catchment area.

Introduction

The classification of actual forest types is essential for effective forest management planning. Classifications of forest types based on water catchments have been recommended (*Wakolo, 1995., MSD; 1995*). An important and cost effective means of carrying this out is through satellite imagery as being performed in other countries. Although, we are restricted with quantitative and qualitative data, we are optimistic for a positive change in the future. However the spectral differences been observed can be used as basis for further forest classification.

Test Area

The test area includes the same Navua Catchment. The water catchment is a mosaiking of south-east quarter scene TM 075 / 072 and north-west qaurter scene TM074 / 073. Date of data acquisition ranges from 25 / 12 / 91 for 075 / 072 and 6 / 3 / 92 for 074 / 073. Other features describing the characteristics of the catchment area are contained in previous issues of this newsletter, see list of references at the end of this article.

Training Areas

The selection of training areas were predetermined using a GIS layer of forest types determined under Howard and Berry (1973). The area selection considered the representation of variable forest types to be investigated and allocated on the Fiji Map Coordinates. The map coordinates were then recorded into the roving GPS for the field identification of plots. Once these plots have been located in the field, another GPS reading must be recorded from each plot preferably the plot centre for the GPS Differential Correction. The GPS Differential Correction is now possible and operational with an accuracy that is acceptable for forest applications in Fiji (*Poidevin, 1994, Poidevin, 1995*).

Each training area comprises of 4 blocks (25 m * 25 m) with north - south orientation to resemble pixel layout. The only quantitative measurement taken was that of tree dbh over 10 cm. The remaining descriptive assessment include tree species, canopy layer, canopy structure and leaf structure. However, other important features like slope, aspect, extent of sunlight penetration to ground level and so on were noted.

TM Imagery data

The Landsat 4 Thematic Mapper data were recorded around December 25th, 1991 and March 6th, 1992 for scenes 075 / 072 and 074 / 073 respectively. The satellite imagery was made available to the National Invenatory Project from 1991 - 1994 and eventually used for the exercise.

Data Analysis

Data analysis for the exercise was performed using ERDAS version 8.2 under UNIX worksattion while other original processing was performed on PC based ERDAS version 7.5.

The original raw Thematic Mapper bands 3 to 5 and 7 were retained. Other derivative bands include the principle component transformation (PC1) which accounts for the best visible variability and three Tasseled cap transformation bands explaining the brightness (TC1), greeness (TC2) and wettness (TC3). The principal component transformation was performed without TM band 1 and band 6. For this report the final image consists of 9 bands. At this stage no ratio bands and other transformation bands will be included.

The differentially corrected GPS readings (FMG coordinates) of the training areas were used to locate the map coordinates with the AOI Tool in the image. These were then expanded to the desired constraining factors under the SEED module and recorded in the signature file if required for further processing. The statistics of the selected training area spectral patterns can then be calculated and demonstrated, for example, in separability via ellipse plots or contingency matrix and divergence.

The traditional supervised technique was used in the classification. The classification algorithm uses a maximum likelihood classifier that considered the statistical spectral variability of training areas and similarly, using the covariance matrices of the training areas for the differentiation. Although, maximum likelihood classifier has inherent weaknesses, its has greater advantages as well which should be exploited in the exercise.

Results

The spectral pattern differentiation by individual selected areas can be graphically demonstrated via signature variability (Figure 1).

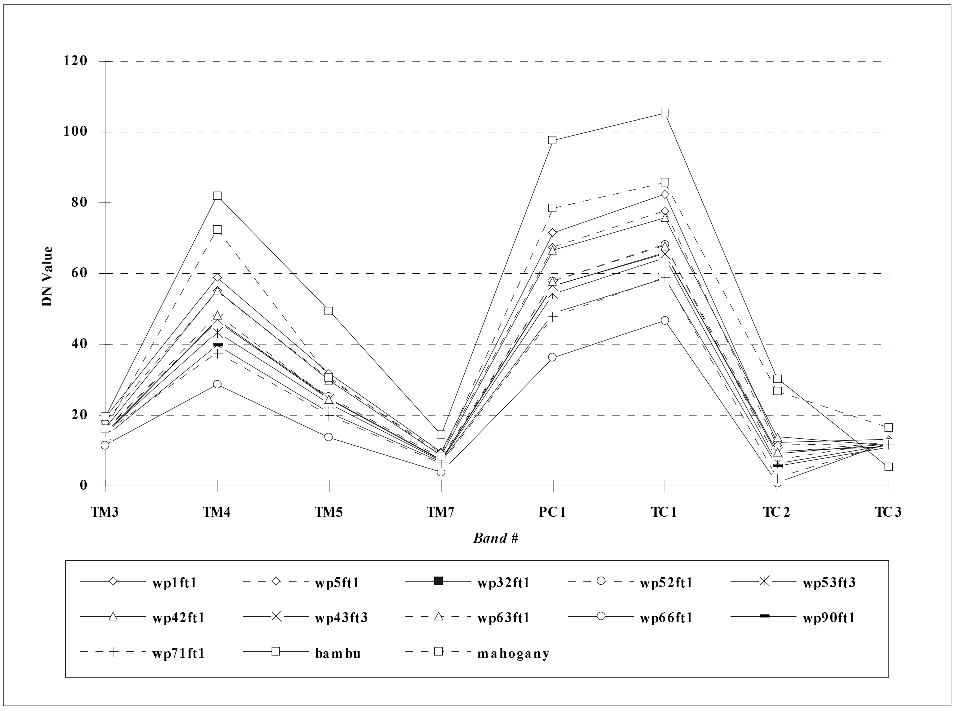

Figure 1. Signature Mean Plot of the Training Areas.

principle component band (PC1) and the Tasseled Cap (TC1, TC2 and TC3) showed great potentials in differentiating these training areas or supposedly forest typing. The supervised classification result was very encouraging. Certain misclassifications were detected and could be resolved with further processing.

Discussion

The intention of the exercise was to continue the classification of forest types based on catchment areas. Secondly, using these various techniques and methodologies to establish more friendly practical link to operational level. It is extremely impossible to locate pure stands of native forests in logged areas and presumably to a large extent in our unlogged forest as well.

It can be derived from this preliminary result that observed spectral differentiations among this originally designated one forest type (ft1) has great potential for more classes. Bamboo growths and the old pure mahogany plantations can be clearly distinguished from the others. The persistent separation of unlogged forest proved very interesting. It can be interpreted from the signature graph that the behaviour of most native forest cover was distinct and consistent throughout. However, water moisture dropped significantly for mahogany, yet its wettness proved highest among all others. A valid explanation could be the resulting impact of its annual refoliation. The bamboo growths showed the least wettness and this was not surprising due to its leave characteristics.

The driving force here is to derive forest types based on its detectable behaviour from satellite imagery. This is only the beginning as more possibilities yet to be tested. Individual characteristics of forest types are becoming obvious and should continue to be investigated and validated with advancing techniques and methodologies.

Acknowledgements

Thanks to the MSD staff members for the additional GPS readings and support.

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■ *by Wolf Forstreuter, MSD-Forestry*

Mapping and Monitoring of Fiji's Hardwood Plantations

Introduction

The European Union financed and assisted a hardwood plantation mapping project in Fiji which is now completed. The purpose was the mapping at 1:10,000 scale and the integration of the mapping into the country wide forest monitoring system based at the Management Services Division (MSD) of Fiji's Forestry Department.

Before the project started only sketch maps were available for most plantation areas and these were of unknown projection with inaccurate boundaries. In order to produce accurate maps within the given time frame, the project used modern equipment and techniques such as Global Positioning System (GPS), stereo mapping, digital satellite images and Geographical Information System (GIS). The experience showed that the combination of these techniques is the right choice for forest mapping. Furthermore, the equipment and technique provided the basis for a continuous update of the spatial plantation information, which can be handled in the country. It is no longer necessary to order this service from overseas companies.

The GPS Application

At the planning stage of the project it was believed that GPS can be used as the only information source for accurate plantation mapping. The experience showed, that this technique has its limitations and has to be supplemented by other ways of mapping.

The field teams followed tracks, roads, creeks and boundaries with the hand held receiver (rover) and recorded the positioning data received from the satellites. Opening the sunroof of the car it was possible to stand upright with the GPS rover and survey forest roads within a short time. After completing the survey of one or two features the rover data was uploaded to a laptop. At the end of a day (in remote areas after two or three days) the data files were transferred via modem and telephone line to MSD.

MSD has its own base station fastened on the roof of the building. The arriving positioning data gathered in the field can be differentially corrected using the data files recorded by the base station at the same time. This correction increases the accuracy to better than 5 metres and this was confirmed on several examples. The disadvantage of the GPS survey was the poor reception of positioning data in valleys under forest cover.

Stereo Mapping Application

Through a former AusAID project, MSD is equipped with an analytical stereo mapping instrument and recent black and white aerial photographs covering the plantation areas were available as well. Due to time constrains and the described difficulties of the GPS survey, this survey was partly replaced by stereo mapping. The aerial photographs have a scale of 1:50,000. In combination with the instrument (ZEISS Visopret) and the newly determined Ground Control Points (GCPs)[1] these photographs provided the necessary accuracy (better than 5 metre). Within a short time all creeks, tracks roads and ridges were stored in files as digital positioning data.

These files was then shifted to the GIS. These features often making the boundaries of sub-areas within the plantations such as compartments or stands. A forest operator deleted all features not marking such sub-areas. Then he imported the GPS survey data to complement boundaries and highlighted areas for which additional information was required. For these areas the GPS field teams visited the plantations again and captured additional data. Later the road network and river system was overlayed with different label allowing a later print in different colour.

The black and white aerial photography at 1:50,000 scale did not allow the separation between plantation and natural forest cover. Only some mature plantation stands can be recognised by the typical texture. This was insufficient for the required monitoring.

Applying Satellite Images

To monitor plantation areas it is necessary to provide information about:

- which areas are planted and where plantation establishment took place outside the leased area
- which areas are still stocked with un-

treated natural forest

• which areas are logged and prepared for planting[2]

Coloured aerial photographs at 1:25,000 scale or larger provide the best information source. However, such information is required regularly and aerial photographs are very expensive to acquire. Digital satellite images[3] proved to be the best alternative. Three steps are necessary to produce plantation image maps:

1. geometric correction, to fit the image into the required projection
2. object specific contrast enhancement to visualise areas dominated by planted species from areas where natural forest dominates the canopy and to separate untouched natural forest from logged and chemically treated parts
3. overlay of the plantation boundaries derived from 1:10,000 mapping

The produced plantation image maps at 1:50,000 scale[4] showed areas which have been planted outside the plantation boundary and unplanted areas within the plantation. However, the time factor has to be considered. It is impossible to identify these parts directly after planting, because they are planted under the umbrella of the natural forest. Before they can be identified on the satellite image the planted trees must dominate the canopy. Nevertheless, the produced image maps proved to be an operational tool for monitoring the plantation development.

Map Production

For change detection of forest cover and any area assessment, digital maps are sufficient. For field work and for visualisation the status and any planning a forestry department must be able to produce their own physical maps.

Maps at the scale of 1:10,000 were produced by a pen-plotter on transparency allowing cost effective dyeline copies.

At 1:50,000 scale coloured maps were produced. An recent natural forest inventory project produced a complete set of maps in Germany. These maps show the forest cover, however, they reflect the situation before the plantation mapping was carried out. From this map production received the infrastructure in the form of the road network and river system as digital data set. These data was created by scanning corresponding transparencies provided by the Fiji's Lands Department. The forest cover information was updated by importing the newly mapped plantation areas into the digital forest cover information. Interpretation of satellite images was carried out for areas which were wrongly mapped as plantation before. Before overlaying the digital infrastructure the pixel size of the forest cover information was reduced to keep the fine structure of linear elements such as creeks, labels etc. An A0 ink-jet plotter was used for final map output.

Such a map does not reach the quality of an offset printing product, however, it provides already an expectable standard and shows the latest forest situation.

Conclusion

The plantation mapping project provided more than accurate plantation maps, it updated the forest monitoring system to an extent that the Forestry Department is able to produce their own maps at 1:50,000 and 1:10,000 scale. It is important to install mapping facilities in the country rather than ordering the product from overseas companies. Further, it was important to install a monitoring and mapping system within the Forestry Department, rather than employing the facilities and knowledge of other Departments. A good forest management requires permanently updated information about the forest cover. Today, a forest map cannot be used for more than five years.

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[1] the GPS facilities were used to establish GCPs necessary for stereo modelling

[2] normally chemical thinning is carried out

[3] the project used multispectral SPOT data

[4] 1:50,000 is the largest scale which can be produced with satellite data available at MSD

■ *by Asesela Wata, MSD-Forestry*

Plantation Image Maps

Introduction

The increasing area of Fiji's hardwood plantations has to be managed. Remote sensing data is an excellent tool to monitor the situation in the field. It is necessary to know the location of logged, over-planted, not planted or vegetation-free areas. Coloured aerial photographs at 1:25,000 scale are the right type of data. However, it is difficult to get frequent coverage. Satellite images cannot be employed to map at 1:10,000 scale, but they provide an overview and they are frequently available.

Producing Plantation Image Maps

Before satellite data can be included into Fiji's mapping system a geometric correction has to transform this data to fit the projection and map sheet coverage. Corrected data is available at MSD, and the geometric correction was explained.

To avoid handling unnecessarily large files out of image files covering one map sheet, subsets have to be separated out just covering the area of the plantation. ERDAS software allows the recording of the geographic reference of the subset. Every picture element has the Fiji Map Grid coordinates of its centre.

Digital images allow an object-specific contrast enhancement. Parts of the image showing grassland, agricultural area etc. are not of interest, but the difference between natural forest and parts of the canopy dominated by mahogany is important. Digital image processing can improve the contrast between these different forest canopies while equalising the features outside forest. The reflection of areas with known forest canopy is analysed by the operator in relation to their range of reflection in each channel of the satellite image. The same is necessary for training areas of natural forest to identify the lowest and highest pixel value in each channel. Then the image is displayed setting all pixels lower than the lowest reflection of forest such as water bodies to zero and all parts of the image showing reflection higher than bright parts of the forest canopy to 255. The range between 0 and 255 is then available for stretching the contrast of forest cover. Agricultural areas cannot be differentiated from cloud cover, and water is displayed unique in black, but the colour showing the forest cover differs in a wide range allowing the identification of mahogany, natural forest and other canopy.

The plantation outline as well as the compartment and stand boundaries are available as ARC-INFO coverage at MSD-Forestry. ERDAS software allows the import of polygons as arcs and converts the corresponding pixel value of an existing image to a value related to the ARC showing the boundary. The process has to be carried out separately for every band of the image. Therefore the image has to be separated into its three bands and later the three bands have to be joined again to one image file. This process can be handled by a batch file.

CorelDraw software is used to superimpose the plantation name and the origin of the satellite data. Before doing this the image has to be converted from ERDAS.LAN file to TIFF file format, which is handled by ERDAS.

ImageAlchemy software is handling the printing processes of image data. This software converts the TIFF file format to an HP-RTL print file. Because of the large space required this print file is not stored on disk. The software allows sending it directly to the printer. Specifying the size of the printed image enables the scale to be determined accurately

Results

The image maps allow a clear separation between:

- natural forest
- natural forest heavily logged or poisoned
- bare soil / grass
- mahogany dominating the canopy

Further it is possible to see:

- areas dominated by Nokonoko velau (*Casaurina equisetifolia*). This can be noted in compartment 4 of Wainunu plantation which reflects more intensive red than the surrounding forest canopy.
- bamboo if dominating the area after logging the natural forest. This can be noted in compartment 41 of Korotari plantation.

Summary and Future Activities

It is impossible to separate areas planted with mahogany from un-planted areas, because the planting is carried out under the remaining canopy of the natural forest. However, satellite images can be used to identify compartments where the planted trees dominate the canopy which occurred after 12 to 14 years. At least after this time over-planted areas are visible. It is also possible to identify untouched remnant natural forest if the surrounding area is affected by chemical thinning. Satellite data proved to a useful tool to help in plantation monitoring.

Further investigations have to be carried out to determine after which time mahogany dominates the canopy, depending on silvicultural treatment and soil. A more detailed investigation is required for the separation of different species such as *Cordia subcordata* or *Anthocephalus chinensis*. ♍

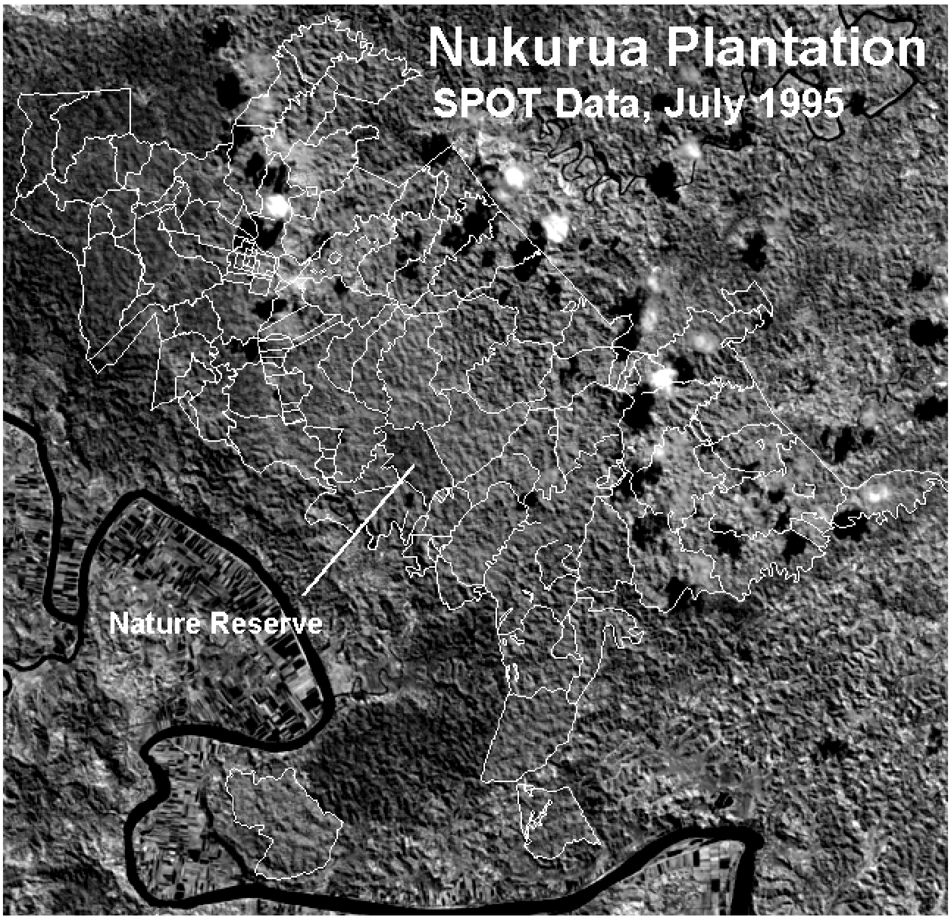

Figure 1. Display of a plantation image map. The original file is reduced and the coloured image is converted to an one band (infrared band) black and white image. It is still possible to see the difference between mahogany and natural forest cover.

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Classification in a Simple Form

Abstract

The purpose is to overview the generalities(a simplified version) of classification. No new ideas are introduced. No prerequiste is assumed but some prior Remote Sensing and Image Processing knowledge would be an advantage.

Introduction

Specific examples of classification for remote sensing application include determining:

1) Tree-species composition in a forest
2) hot spot of incipient forest fires
3) natural vegetation cover-types
4) crop types
5) state of health or stressed vegetation
6) percent of sedimentation in a river or lake
7) percent of pollutant in a river or lake
8) geological formation and rock types
9) lineament patterns
10) degree of mineralisation
11) urban land-use patterns

To carry out a classification, we must first define the classes of entities of interest, that is the kinds of objects between which we must discriminate. We must provide a methodology permitting the recognition of an object in the class of objects of interest. Using this methodology we also must construct a decision rule which will decide what kind of object a particular object is, on the basis of the measurements made from the observed small-area ground patches.

Most classification of remotely sensed image data is done by processing each pixel's information separately or independently. This means that a category assignment is made to each pixel purely on the basis of its own information. When it is the decision rule which makes category assignment that uses the information from a pixel and some of its neighbouring pixels then the classification is called spatial classification or spatial spectral classification.

The training data is used for each class to determine the class sample-mean. The measurement space is then partitioned so that each class is associated to the measurement class closest to its sample mean.

Feature selection

Multispectral (data obtained using several bands) remotely sensed imagery can produce a very high dimensional data vector for each pixel. The data has inherent redundancies and processing all of the data or storing all of them may not be cost effective. Feature selection procedures are used to select those dimensions most suitable for processing.

Some of the two kinds of feature selections depending on whether the classes and their statistic are known or not. If they are not known the best feature selection procedure is called principal components. If they are known the easiest-to-use feature selection is based on Bhattacharyya distance.

Pricipal components is a standard statistical technique for selecting that subspace of a given dimension in which the most data variance lies. If Xi ......Xn are the sample data vectors, μ the sample-mean vector and S the sample covariance-matrix, the best K dimensions in which to project the data would be the K eigenvectors of S having the lowest eigenvalue.

Bhattachararyya distance is a measure of the separability between two classes. For two Gaussian classes having means and covariance μ1, S1 and μ2, S2 respectively, the Bhattacharayya distance is given by:

$$1/8\ (\mu_1-\mu_2)'\left[\frac{\Sigma_1+\Sigma_2}{2}\right](\mu_1-\mu_2) + 0.5\ \ln\frac{\left|\frac{\Sigma_1-\Sigma_2}{2}\right|}{\sqrt{|\Sigma_1|}\sqrt{|\Sigma_2|}}$$

Classification processing

Remote sensing classification is the process of sorting pixels into a fixed predetermined number of classes, or categories of data based on their data file value. If a pixel satisfies a certain set of criteria, it is assigned to the class that corresponds to that criteria. This process is also referred to as image segmentation.

Supervised classification: The indentification of pixels is done based on previous knowledge. Identify an area of the image that can be identified using ground truth information. This process is called taking a training sample. Statistical computation is carried out for this area (mean, covariance, standard deviation). A set of training samples is called a spectral signature. A pixel by pixel classification is then perfomed on the multispectral image data.

Unsupervised classification: The pixels that look alike or have the same characteristics are grouped together and is given a label. The user then interprets the classes chosen by the algorithm used. Requires very minimal initial input from the user, that is to identify the number of classes desired.

For instance to visualize the classification, each class is given a symbolic colour to represent its characteristic.

Signatures

The result of a training sample is a set of signatures that defines a training sample or cluster. Each signature corresponds to a class, and is used with a decision rule to assign the pixel in the image file. The two types of signatures are:

A *parametric signature* is based on statistical parameters (eg. mean and covariance matrix) of pixels that are in the training sample or cluster.

A *non-parametric signature* is not based on statistics but on discrete objects (eg. polygons or rectangles) in a feature space image. These feature space objects are used to define the boundaries for the class

Distance definition

A signature is a point in a spectral space (up to n dimensions). To produce sub-space of this space, it should be possible to fix limits, which comes down to measuring distance between signatures. There are several methods to measure the distance in a given space, which are usually grouped in three major categories:

1) circular distances (euclidean, chebychev etc)
2) elliptical distances (quadratic, by correlation etc)
3) conical distances (chi squared)

note: A distance between two points in the spectral plot bears no relationship to ground distance but instead represents a spectral distance between these two points.

Minimum distance : Is the spectral distance between a given pixel and the mean of each signature. This pixel is assigned to the class for which the mean is the closest.

The equation for Euclidean distance :-

$$SD_{xyc} = \sqrt{\sum_{i=1}^{n}(\mu_{ci} - X_{xyi})^2}$$

n = number of bands (dimensions)
i = a particular band
c = a particular class
Xxyi = data file value of pixel x , y in band i
μci = mean of data file value in band i for the sample for class c
SDxyc = spectral distance from pixel x , y to the mean of class c

Mahalanobis distance: Is similar to minimum distance, except that the covariance matrix is used in the equation:-

$$D = (X - M_c)^T (COV_c^{-1}) (X - M_c)$$

D = Mahalanonbis distance
c = a particular class
X = the measurement vector of the candidate pixel
Mc = the mean vector of the signature
COVc = the covariance matrix of the pixels in the signature of class c
$COVc^{-1}$ = inverse of COVc
T = transposition function

The pixel is assigned to the class, c, for which D is the lowest. Mahalanobis distance takes the variability of classes into account. However it tends to overclassify signatures with relatively large values in the covariance matrix.

Maximum likelihood / Bayesian: The maximum likelihood is based on the probability that a given pixel belongs to a particular class. Assume that these probablities are equal for all classes and that the input bands have normal distributions.

The equation for the maximum likelihood/Bayesian is:-

$$D = \ln(A_c) - [\, 0.5 \ln(|COV_c|) \,] - [\, 0.5 \,(X-M_c)^T (COV_c^{-1}) (X - M_c) \,]$$

D = weighted distance
c = a particular class c
X = the measurement vector of the candidate pixel
Mc = the mean vector of the sample of class c
Ac = percent probability that any candidate pixel is a member of class c
COVc = the covariance matrix of the pixel in the samlple of class c
|COVc| = determinant of COVc
COV^{-1} = inverse of COVc
ln = natural logarithm function
T = transposition function

The pixel is assigned to the class, c, for which D is the lowest.

Types of decisions

Parallelepiped: A signature is represented only by a minimum and a maximum data value in each band of the image.

Minimum distance: The decision is based on the spectral distance between the mean pixel value and the pixel to be classed.

Thresholding: The user specifies a maximum allowable value for distance values, which is the threshold value. If the distance of a pixel is greater than this threshold value, the pixel is assigned to a background or unclassified class.

Conclusion

In many Remote Sensing applications, the final stage of image processing is to perform a method of classification of some kind from the list of methods proposed on an image file. Classification enables to highlight some certain characteristics in an image and varies according to ones needs. As an example a urban developper would highlight only building and road structures while a forestery person would highlight only vegetation regions etc etc. Non parameteric and Neuronal network methods are now being proposed in many articles. ♍

■ *by Wolf Forstreuter, MSD-Forestry*

E-mail for Forest Mapping

Introduction

The Management Services Division (MSD) of the Forestry Department has e-mail access via SOPAC[1]. At the same time problems exists regarding transfer GPS survey data from Vanua Levu to Colo-i-Suva for further processing. It seemed logical to investigate the transfer of data using the e-mail access. Normally, GPS survey is carried out for one or several weeks until the team returns together with the survey data on laptop computer disk and floppy disk backup. At MSD, a differential correction is performed and then the data is displayed for a check of completeness. If data is lost, inaccuracy is visible due to bad satellite reception, the survey team plus car has to go back by ship to Vanua Levu to repeat the work. This is time consuming and costly. The European Union saw the problem and provided as part of the funded inventory project a laptop computer with a modem for data transfer.

Sending Data from Other Islands

In the field, the GPS rover[2] data is down loaded once or several times a day. Each file containing survey data of one boundary, one road or one or several ground control points has a file name indicating the rover unit and the month, day and hour of receiving. If there are more than one file recorded per hour they can be distinguished by the additional letter (see Figure 1 below).

For every file the forester writes an ASCII file with the same file name but an extension TXT containing the:

1. start of the rover file (year, month, day, hour) local time.

2. feature surveyed e.g. boundary between compartment 11 and 7.

3. noticed survey problems e.g. bad receiving at 11:35.

4. end of the rover file (year, month, day, hour).

At the end of a day the team leader condenses all files recorded during the day into one ARJ[3] file. The filename indicates year, month, and day. This sequence allows the automatic order by common software.

Whenever the team visits a forest station with a functional telephone line the team leader connects the modem of the computer with the GPS mailbox at SOPAC. The ARJ file containing all survey data is attached to an e-mail he sends to the mailbox.

Receiving Data at MSD and Advising Performance

Whenever MSD connects to its mailbox at SOPAC it will receive mail with attached survey data files, because these are sent automatically from the GPS mailbox to the normal MSD mailbox. MSD normally connects three times a day to its mailbox at SOPAC.

If MSD receives a message with an attached survey data file it can be differentially corrected[4] within a short time, because the base station data is downloaded every day. The corrected data then can be overlayed and displayed in the GIS that

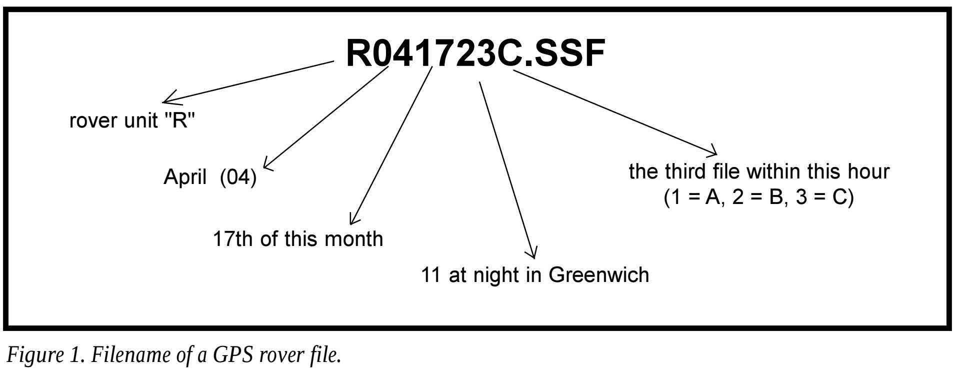

Figure 1. Filename of a GPS rover file.

identifies any inaccurate survey caused by low receiving visibility.

MSD then sends a message to the GPS mailbox at SOPAC telling the field team if they have to repeat the survey, which normally is an exception. The field team receives this message when they connect to the GPS mailbox again to upload the next survey data. If the team has to repeat a survey it is still in Vanua Levu and most likely still in the vicinity of the plantation site.

Conclusion

The modem provided by European Union saves time and effort. It should be investigated if a general data link via modem to the northern division can cut down on communication problems. The described example also shows that a (regional) - technical organisation such as SOPAC becomes an integral part of the process in providing access to new technical facilities, which are not always experienced in practice.♍

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[1] SOPAC = **So**uth **P**acific **A**pplied Geoscience **C**ommission
[2] a GPS rover is a hand held GPS receiver storing the position data
[3] ARJ is the extension indicating a file created by ARJ compressing software
[4] GPS survey requires a differential correction to increase the accuracy. Therefore a base station is necessary which is based at MSD in Colo-i-Suva

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ORGANISATION/FAX

A & P Development Consultants, 384766
Australian Embassy, 300900
Bureau of Statistics, 303656
Delegation of the Commission of the European Community, 300370
Department of Energy, 386615
Department of Environment, 303515
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Public Works Department, Water and Sewerage Section, 315244
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South Pacific Commission, 370021
South Seas Computing, 370875
Tuvalu Embassy, 301023
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UNDP, Regional Water and Sanitation Project, 302487
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Wood & Jepson Consultants, 303361

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Bunnings Tree Farms Pty Ltd, Australia
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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
Department of Conservation & Resources Surveillance
Division of Forestry, Federated States of Micronesia
GOPA Consultants, Germany
Bureau of Planning, Guam
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Ministry of Environment and Natural Resource Development, Kiribati
Ministry of Foreign Affairs & International Trade, Kiribati
Ministry of Home Affairs and Rural Development, Lands and Survey Division, Kiribati
Marshall Islands Marine Resources Association, Marshall Islands
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Ministry of Foreign Affairs & Trade Relations, Solomon Islands
Ministry of Natural Resources, Forestry Division, Solomon Islands
Ministry of Natural Resources, Geological Survey Division, Solomon Islands
New Zealand High Commission, Honiara, Solomon Islands
Department of Agriculture, Tonga
Ministry of Fisheries, Tonga
Ministry of Foreign Affairs, Tonga
Ministry of Lands, Survey and Natural Resources, Tonga
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Department of Lands & Survey, Tuvalu
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United States Forestry Service, USA
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