GIS & REMOTE SENSING NEWS

FIJI USER GROUP Number 6, May 1994

MARCH NEWS

The meeting was held at SOPAC, 8 March 1994.

SOPAC explained the memorandum understanding related to change of GIS and Remote Sensing data. Whenever there is a user buying space borne remote sensing data, a second user only has to pay a copy fee if he wants to use the same data for his purpose. Before this user was forced to buy the data again.

FLIS explained that the road index, which is a relational data bank holding name, quality and length of all roads in Fiji, is completed. The GIS Council Meeting has signed an agreement, that a government department cannot take another government department to court related to inaccuracy of GIS or data.

NLTB talked about the ongoing training at FLIS. The activities for transfer of spatial data to FLIS and from there to other user continues.

MRD is active in data base update with FoxPro and in-house training is ongoing.

MSD explained that the data bank containing forest area stratified into:
- dense natural forest
- medium dense natural forest
- scattered natural forest
- mangrove forest
- hardwood plantation
- pine plantation
- coconut plantation

and also stratified into:
- multiple use forest
- preserved forest
- protection forest
- multiple use plantation
- amenity plantation
- mangrove

is completed for the first area assessment. The figures are available at Forestry Headquarters. The area calculation is an output of a GIS-analysis using digital classified Landsat TM data. The analysis was transferred to the data bank established with dBase IV (see last GIS/RS News). An A0 ink-jet plotter and a laminating machine for this size arrived at MSD which can be used also by other user for map printing. MSD placed a programming request to archive a multispectral SPOT scene from Namosi district in Viti Levu.

Lands Department highlighted, that 6 maps of the new topographic series are now published.

PWD outlined training.

The Fiji GIS catalogue was presented as an initial combined SOPAC/MRD/MSD document. Other users indicated their interest in accessing as well as providing contributions to the catalogue.@

Welcome to the sixth issue of this newsletter. This issue reports on two User Group meetings and the focus is on remote sensing. A comprehensive report on the 7th Australasian Remote Sensing Conference is provided by SOPAC while MSD explains the uses of Digital Terrain Models, the use of aerial photography for GIS and the storage of irreplaceable data on a more permanent medium. A GPS supplier provides information about the new generation of these instruments and an environmental consultant reports on environmental parameters in a GIS application. The ongoing concern about lack of remote sensed data for the Pacific is reflected several times in this issue and it is a problem that must be met by encouraging providers to meet the increasing demand for suitable data which is timely and cost effective. Meanwhile, we look forward to your continuing support through any articles, tips or **hints.**

APRIL NEWS

The meeting was held at MSD/ Forestry, 12 April 1994.

Kevin McConell from Lukemine Enterprises explained the improvement of Global Positioning Systems (GPS). The GPS now works better under the forest canopy due to more satellites in space and faster calculation of the positioning by the software of modernised instruments.

Mike Poidevin (MSD) explained the advantage of the Fiji Map Grid (FMG). He also mentioned some small problems such as the spheroid used for FMG, WGS72. GPS signals are based on the WGS84 spheroid. For FMG the GPS has to convert from WGS84 to WGS72. This cannot be done absolutely accurately because the systems only take world wide transformation parameters into account and do not base the calculatio of the more accurate parameters for Fiji only.

Michel Larue **(SOPAC)** recently returned from Australia where he attended the 7th Australasian Remote Sensing Conference in Melbourne. He outlined developments in remote sensing and a report is included in this newsletter.

Sunao Koriki (MSD) explained ideas of mapping logged-over areas in Fiji. The present situation does not allow an accurate survey of selective logged areas, because such logging cannot be recognised with the type of remote sensing data available at present. He will undertake the needed survey terrestrially by using GPS systems. The systems will record, the co-ordinates while going along the boundaries between logged and unlogged areas. Later, these co-ordinates can be downloaded to a GIS for map production.

Osea Tuinivanua (MSD) explained the potential of data stored at MSD. They can be used also for limited areas such as the possible Mount Evans Range Tourist Park. Spatial data such as soil map, forest cover map etc. and non spatial data such as species per hectare, minor forest products per hectare or timber volume per hectare can be utilised. The system at MSD allows a separate extraction of information for a particular area. However, the information still has the accuracy of 1:50,000 scale. For a small area a scale of 1:10,000 should be used. This would require additional field sample plots for the non spatial data and analytical aerial photo analysis plus GIS operations for spatial data. The method, software, and the hardware are available at MSD. but the iob must be done in such a case.

Leslie Allinson **(SOPAC)** talked about the advantage to have a bigger PEACESAT station here in Fiji. PEACESAT is a communications satellite based network which allows voice and data exchange. Point-to-multi-point voice connections allow conferences which can include many countries of the South Pacific. A bigger antenna and new technology would allow the exchange of spatial data via satellite. Some pre-processing of data could be done at locations where necessary hardware and software is available, without sending them on tape via postal service.

During the **discussion** MSD explained the purpose of the natural forest Inventory during the last two years in response to an inquiry by the Department of Environment. It was clarified that this inventory was not limited to the commercial timber resources only. Much data relevant to the environment has been captured and environmental experts have taken an active part in the work. A country wide mapping of more than three density classes of tropical rainforest using remote sensing data would need much more investigation which is impossible to do within a such time limit.

During the discussion the visit of an UN/ ESCAP representative was mentioned, who wanted to look for a national GIS and Remote Sensing Centre. He visited Lands Department, MSD and SOPAC. MSD explained during his visit the need for a movable ground station to receive Landsat TM, Indian Satellite or radar images from the European Satellite ERS-1. He promised to bring up the issue on the international Remote Sensing Conference in China, this year. He also suggested that the issue could be brought forward by the Minister of Lands who will be attending this conference. SOPAC reported that he had visited that organisation with the view of funding a small oroiect. It was suggested that a project to investigate sea surface temperature using NOAA satellites would be beneficial to the region, in particular the fisheries resources, but due to funding limitations it did not appear possible.

SATELLITE NEWS

Data from Russian space vehicles
EOSAT has signed a data source agreement with Sovinformsputnrk of Moscow, Russia, to distribute their high-resolution satellite imagery worldwide (EOSAT Notes No. 3/4 1993). See also Russian Spaceborn Photographs For Civil Use in this newsletter.

Data from Indian satellites
In GIS/RS News No.3 January 1994 we stated that EOSAT signed an agreement for receiving data from the Indian RS-satellites with their ground antennas and that they will distribute this Indian satellite data.

In October 1994, India will launch **a** new satellite IRS-1 C while the first two satellites IRS-1 A and IRS-l B are still operational. This satellite has a revisit time of 24 days (at the equator) and will carry three sensors (EOSAT Notes No. 3/4 1993).

- LISS-III (Linear Self Scanning Sensor) with 20 m resolution for the first three bands, the second infrared band will be recorded with 70 m ground resolution. The sensor **covers following** spectral bands:

Green	0.52 - 0.59 mm
Red	0.62 - 0.68 mm
Near Infrared	0.77 - 0.86 mm
SW Infrared	1.55 - 1.70 mm

LISS-III, as opposed to the former LISS-I and LISS-II (see GIS/RS News, January 1994), no longer records the blue spectral band which is a disadvantage for underwater mapping of shallow coastal areas. However, the sensor now records the part of the reflected infrared band which is influenced by the plant water content. This can be of importance for vegetation stratification (see 0. Tuinivanua "Possibilities of Mangrove Mapping" GIS/RS News, October 1993).

- Panchromatic Camera. The camera takes images with 10 m spatial resolution and covers the visible wave length (0.5 and 0.75 m).

The panchromatic camera will have similar resolution to panchromatic SPOT data.

- WiFi. This Wide Field sensor has an approximately ground resolution of 188 m. Because of 740 km swath the repeat coverage drops down to 5 days. The wave **length** covered:

Red	0.62 - 0.68 mm
Near Infrared	0.77 - 0.86 mm

This sensor will be very useful for change detection on a country wide level 1:500,000 scale. An example would be land use and deforestation.

Unavailability of data for the South Pacific
At present the data from the planned IRS-1C satellite is not available for the South Pacific because there is no receiving station and no possibility for downloading via relay satellite. Therefore, any kind of monitoring with space born data is limited to:

1. SPOT 3 with the on-board tapes
2. the Russian satellites and their optical cameras,
3. the Russian space station with their cameras and the digital scanner (MOMS-02)

Another area of concern is the unavailability for South Pacific countries of Landsat TM or radar data from the European Satellite ERS-1. Even the portable ground station will be of limited use due to the restricted station window which limits coverage to only a few islands. A solution would be to access the data via a relay satellite.@

■ by Michel Larue, Mapping Geologist, SOPAC

7TH AUSTRALASIAN REMOTE SENSING CONFERENCE, MELBOURNE 1-4 MARCH 1994

Remote sensing is the art of getting as ***far as*** possible from a problem ***and still*** pretend we ***can say and do*** something about ***it.***

The three combined conferences, 7th ARSC[1], PORSEC 94[2], and ISPR[3] put emphasis on the complementary aspects of those techniques. Since the adoption of agenda 2 1 at the Earth Summit in Rio, 200 millions hectares of agriculture land has been lost worlwide, leading to the recognition that' the greatest threat to the environment is the population pressure and overuse of land, clean water and sanitation. In Australia, the contribution of agriculture to total revenue reaches 22.5 Billions A$, but land degradation process decreases this amount by 600 M A$ a year. The chapter 11 of Agenda 21 focus on the need for monitoring this evolution by collecting scientific information and deliver it to manager.

In spite of this need, the development of remote sensing has been in some ways disappointing, why? Several reasons can be identified: poor adoption of a new digital technology addressing a conservative user community, problems of data distribution, lack of efficient user/government interface, lack of ***Real*** World marketing by the government space agencies responsible for satellite programmes. Market approach concentrates on development revenue generating application as opposed to satisfying scientific research data requirements. When the market is not pulling naturally, there is a need for significant resource to replace it by a push by technology. What are the market requirements? Up to date accurate global geographic information? One of the major element of a market-oriented approach is a pricing policy. Data and product have to be setup at a level corresponding to their perceived value market. The distribution of only large images is not adequate to the market situation in Australia.

[1] Australasian Remote Sensing Conference
[2] Pactfic Oceanographic Remote Sensing Conference
[3] lnternational Photogrammetry ***Conference***

where some sub-images (l0*10 km) in geocoded form should be made available for specific applications. The situation will change as soon as Rem-ote Sensing will be recognised as a primary source of raw data which has to compete or be combined with other sources of data.

A Data Provider Forum gave examples of the evolution of the market, in technical as well as in market terms. The situation is characterised by a follow up of most of the programmes, with a consistency maintained with the previous platforms. When changes are made, they bring improvement of the characteristics, such as the number of channel, the resolution and the repetition time. One example is given by EUMIXSAT, a European Meteorological Satellite that will replace the existing Meteosat over Europe. Consistancy will be maintained with METEOSAT and GMS.

Characteristics	Present MeteoSat	Planned
channels	3	12
Resolution	5km	3km
Time between images	30 mn	15mn

SPOT: The present situation is that SPOT 2 has no more recording capability and has to download the data to a ground station in real time. SPOT 3 has succesfully been launched and is working well. SPOT 4 is ready to be launched in 1995. SPOT 5 and 6 are in the study phase B in 1994. The improvements considered are along track stereo, increased resolution to 5 m in Panchromatic, 10 m in MSS and the addition of a medium infra red with 20 m resolution, but no decision has been made so far.

ERS- 1: Launched the 17 July 199 1, its main payload consists in several radar systems. It has no recording capability for its SAR therefore there are no data available over the South Pacific. ERS2 is a twin with in addition 3 visible bands, a sea surface temperature and GOME, global Ozone Monitoring Experiment.

EYEGLASS: This is a typical result of the declassification of the military technology. It is a consortium of three companies: GDE, which will provide ground stations, they already provided DMA with their equipment, Orbital Science, will build the satellite, and ITEK will provide the camera and lenses. The images will be Panchromatic, 1 meter resolution, no recording capability, stereo capability with 7 m vertical accuracy, which will enable cost-effective generation of geodetically correct 1:25,000 scale maps. Satellite revisit time 1% days.

LANDSAT: Landsat 5 is still living and working well. It is transmitting data to ground station in line of sight. Therefore if data is needed over the Pacific, the only way to do it is to install a portable receiving station somewhere in the region (Fiji). There can be possibilities but all the potential users should get together to share the resource. The Pacific Remote Sensing User Group should take initiative in this direction.

RADARSAT provides an example of the new marketing companies. It has been designed as a commercial company that will be launching a radar satellite in the first quarter of 1995. The data will be available on a commercial basis by mid 1995. The primary interest for Canada is to provide informations about the navigation situation related with ice in the Arctic. But the company has been designed from the start on a commercial basis, and not as a governmental agency. The details of the satellite are attached. Some of the data will be available 4 hours after collection, to be broadcast to Artic coastguards.

Technical characteristics

Frequency/Wavelength	5.3 GHz/Cband 5.6cm
RF Bandwidth	11.6,17.3 or 30 MHz
Max Data Rate	85 Mb/s - 105 Mb/s(R/T)
Antenna Size	15m*l.5m
Antenna Polarisation	HH
Launch Mass	2750 kg
Design Lifetime	5 years
Altitude	793-821 km
Inclination	98.6”
Period	101 mn
Acending Node	18:00 hrs
Sun-synchronous	14 orbits per day
Cover (Whole Earth)	Every 6 days

Imaging modes

MODE	Resolution Range(l) azimuth, m	Looks (2)	Width (km)	Incidence Angle (3)
Standard	25’28	4	100	
Wide(l)	48-30’28	4	165	20-31
Wide(P)	32-25’28	4	150	31-39
Fine Resolution	11-9’9	1	45	37-48
ScanSAR (N)	50’50	2-4	305	20-40
ScanSAR (W)	100’100	4-8	510	20-49
Extended (H)	22-l 9’28	4	75	50-60
Extended (L)	63-28’28	4	170	1 0-23

(1) Nominal; groundrange resolution varies with range
(2) Nominal; range andprocessordependant
(3) incidence angle depends on sub-mode

Present and future Oceanographic Satellites

Physical oceanography, with global programmes such as WOCE. is a heavy user of satellites. Numerous programmes are making use of satellite data.

Satellite	SPONSOR	SENSORS COMMENTS	LAUNCH	STATUS
PolarSeries	NOAA	IR(AVHRR), ARGOS	Onging	Operational
Geostationary	NOAA	IR. VS, Radiation	Onging	Operational
GEOSAT	USN	ALT	Mar 1985	Completed late 1989
MOS-IA	Japan	OC. VS. IR. MR	Feb 1907	Operational
DMSP Series	USAF	MR (SSM/I)	June 1987	Operational
SPOT2	CNES	VS Doris Tracking	Jan 1990	0perational
ESA ERS-1	ESA	ALT, CSAR, CSCAT, IR	June 1991	Operational
NASDA JERS-1	JAPAN	SAR (L). high& low Res vs (Stereo)	Feb 1992	Operational
TOPEX/POSEIDON	NASA CNES	ALT.GPSTmdhg. MR ALT. DORIS Tracking	Aug l992	Operational
Sea WIFS 1	(Orbit Sci. Cap.) NASA	OC (8bands)	Late 1994	Approved
ESAERS-2	ESA	ALT, CSAR. CSCAT, IR	1994+	Approved
RADARSAT	CANADA	SAC (C)	1995	Approved
ADEOS 1	JAPAN	VS(AVNIR). OC&IT(OCTS)	Early 1996	Approved
GFO (Geosat Follow On)	USN	ALT	Mid 1996.-2001	Approved for #1
GAMES	CNESiNASA	GPS for Gravity	-1998	Doubtful
TPFO (Topex Poseidon Follow on)	NASA/CNES/NOAA	ALT. Tacking, MR	1st1998	under consideration
EOSAM&PM	NASA	CC. VS. IR. (MODIS N)	Late 1998+	Approved
ENVISAT	ESA	ALT, ASAR(C). OC (MERIS) ATSRR (MR), PRAREE (tracking)	1998+	Proposed
Sea WIFS 2	NASA+TBD	OC	1998+	Proposed
ADEOS 2	JAPAN	OC &IR (GLI). MR SeaWinds (-Ku-SCAT)	1999+	Approved
METOPS	ESA	ASCAT(C)	2000+	Proposed
EOS Series	NASA	ALT (Proposed) Ku-SCAT (proposed)	2002+	Tentative

ALT - Altimeter
SCAT - Scatterometer
SAR - Synthetic Aperture Radat
OC - Ocean color radiometer
MR - Passive microwave radiometer
IR - Infra-red radiometer
VS - Visible radiometer

JERS-1: For the region, amoung the most promising new sources of data are the SAR, Synthetic Aperture Radar which is able to provide images through a cloud cover. There are already some JERS-1 images collected over Fiji, here is the list of the SAR images collected. The price of these images is 125,000 Yen (-1800 F$) for a Standard Geocoded Image, Pixel size 12.5 m, Map Projection UTM.

Path	Row	SAR/OPT	Date.	Lat	Lon
632	327	SAR	1993/09/29	-15	178
632	328	SAR	1993/09/29	-16	178
632	329	SAR	1993109129	-17	177
632	330	SAR	1993109129	-17	177
632	331	SAR	1993109129	-18	177
632	332	SAR	1993109129	-18	177
633	327	SAR	1993/09/30	-15	177
633	328	SAR	1993/09/30	-16	177
633	329	SAR	1993/09/30	-17	177
633	330	SAR	1993/09/30	-17	177
633	331	SAR	1993/09/30	-18	177
633	332	SAR	1993/09/30	-18	176

Physical Oceanography

In the past years, new developments of large scale to global studies, such as TOGA and WOCE took place. It is a critical issue to how the data can be made accessible to scientists of developing countries. For instance the monitoring of ENSO[4] brings intense interest among the countries that experience it. We now know that the central Pacific initiates changes of the climate both at a regional and global level. Calibration, ground truthing of the data is an important aspect of the global ocean monitoring system. TOGA programme for instance is providing reliable information concerning the evolution of ENSO. In several places around the Pacific Basin this information is already used to improve the mid term management of economic activities. For instance, in Chile, if a dry season is expected, rice crop is replaced by corn. Similar information could be used in the region and SOPAC could be the best organisation to carry out such a work.

4 El Nino Southern Oscillation

For furfher information, contact Michel Larue, *Mapping Geologist, SOPAC. tel: 381377,* fax: 370040.

■ by **Dick Watling**

The USE OF ENVIRONMENTAL VARIABLES IN FIJI'S FORGIS

Dick Watling, Principal of Environmental Consultants Fiji, recently was attached to the Management Services Division, Ministry of Agriculture, Fisheries & Forestry to assist in the development of Potential Forest Function Maps of Fiji's natural forests. This article outlines how the mops mere developed and how some environmental variables *were used.*

A Policy Document

1:50,000 maps depicting Potential Forest Functions for Fiji's natural forests have been produced by overlaying ten GIS layers with different place values using ERDAS GIS program. After consideration and perhaps further development, the objective is for the maps to provide a Department of Forestry policy base for forest use. The maps and the FORGIS (Forestry Geographical Information System) provide the opportunity for a major advance from the LRD maps which are currently used by the Dept. of Forestry for forest management purposes. The LRD maps, also at 1:50,000, depict different forest associations based solely on species composition and the timber volume. This narrow perspective is now outdated for sustainable forest management and the LRD data source are also outdated being derived from aerial photography of the early 1960's and in parts, the 1950's. Nonetheless the LRD maps remain a valuable management tool and with further development of the FORGIS they could be used to complement the Potential Forest Functions maps.

MSD BREATHES A SIGH OF RELIEF

Two and a half years of work lay at risk of being lost. Over 1,000 high density diskettes contained the digitised map sheets and forest cover derived from satellite image analysis for all the major islands in Fiji. Slowly these diskettes were becoming useless due to the slow but inevitable effect of a common forest life form: fungus.

With the help of the local computer dealer South Seas Computers (SSC) we identified a magneto-optical (MO) storage solution that beats the fungus. The MO disk is the size of a 3.5" floppy disk but holds 128 MB, almost 100 times as much. It is similar to a compact disk (CD) except that the MO disk is both readable and writeable. Larger MO disks the size of a music CD can hold 650 MB or 1.3 GB, however, MSD decided to use the smaller ones to split the risk again. The MO disks are a cheaper storage medium than floppy disks on a per-megabyte cost, and they are basically easy to use.

Once the immediate fungus problem was solved, we discovered additional benefits of the MO drive. First, we can use the MO drive as a transfer medium to get the data to other GIS users. The model SSC identified is an external unit attached through the printer port. We can easily move the drive from one computer to another. Each MO disk is like a removable hard disk.

Second, the MO drive has made the work of the MSD much more productive, reducing three days of tedious work into an overnight, automated task. In order to produce the Forest Function Maps (see Osea Tuinivanua GIS & RS News February) we must combine several digital layers for the 41 map sheets containing natural forest. This laborious process involved too much human intervention: finding the right diskettes among the over 1000, swapping diskettes in and out of the computer, waiting for the computerto finish a process, etc. Three layers of 41 map sheets normally fit on one MO disk, so we have been able to automate the process of combining the layers by putting all the commands and programs into an ERDAS batch file. Now, we start the batch file before leaving in the afternoon and when we come in the next morning, the job is done.@

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The Potential Forest Function classification is a three-stage hierarchical system, the first stage components being Natural Forest Use and Plantation Forest Use with the second stage components being Multiple Use Natural Forest; Protection Forest; Preserved Natural Forest and Amenity Plantation: Timber Plantation respectively.

The overwhelming advantage of using the FORGIS to develop Potential Forest Functions maps and a policy base for the Dept. of Forestry is its flexibility and ability to capture a wide variety of variables for inclusion. It is this flexibility to capture a wide variety of data and update them whenever the data are improved or refined which makes the

FORGIS a most powerful tool for forest management. However, its use will require changes in conceptual thinking by forest managers which will require further education and appreciation, and also the development of new administrative procedures to incorporate inter-departmental consultation for the periodic revision of the Maps.

Important amongst the data which are Included in FORGIS are environmental variables, which in the LRD maps were either ignored or subjectively included. The LRD maps included a consideration of landform but there is no objective explanation of how variations in landform were used to determine the recommended function and how this varied with the key determinant of the LRD maps, timber volume. In FORGIS, slope, soil type and other parameters, both spatial and non-spatial, (Figure 1) are Included in an objective manner which is easily comprehended and, very important, easily modified on the basis of advances in knowledge or technique.

Slope

Topography has been introduced as a layer in FORGIS and in the table across are the recommended slope classes for Potential Forest Function analysis. These classes have been selected following a review of relevant studies and precedents:

Erosion **Risk**

Erosion Risk is a derived layer in FORGIS using 4 separate layers:

1. Slope class - as discussed above.

2. **Soil** erodibility - based on the current soil maps for Fiji, eleven generic soil types were recognised and these were classified into four erodibility classes

3. **Rainfall intensity** - iso-erodent maps were prepared from iso-hyetal rainfall maps using the procedure of Roose (1977) following an endorsement of its applicability in Fiji by Morrison (1992). The procedure uses the simple relation between the Rainfall Factor (R) and the mean annual rain (H), such that: R/H = 0.5 f 0.05 and is considered appropriate as a preliminary measure, until such time as Fiji's

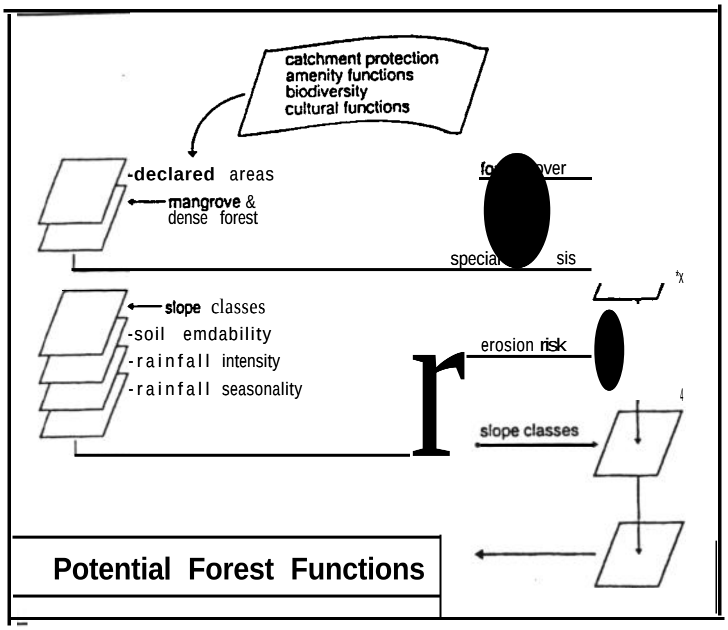

Figure 1. **GIS** *overlay* analysis system

SLOPE %	x°	DESCRIPTION	GIS VALUE
0 - 30	0 - 16	Low	1
30.1 - 50	16.1 - 27	Moderate	2
50.1 - 60	27.1 - 31	Steep	3
over 60	over 31	Extreme	9*

Note: '*' The value 9 is given to provide a distinguishing character for extremely steep slopes which is *used to override* other contributors in the **identification of Protection** Forest. Thus *any* forest area over 30% is immediately recommended for Protection Forest irrespective of other characteristics.

rainfall data can be analysed to provide Rainfall Factor **R** at each rainfall recording station, the R-factor quantifies the erosive forces of rainfall and runoff. Three classes were distinguished.

4. Rainfall seasonality - a very commonly used Index which has been shown to be significantly correlated with sediment yields in rivers (Fournier 1960) is the ratio of p^2/P, where p is the highest mean monthly precipitation and P is the mean annual predpitation. Two classes were distinguished.

Declared Areas

A wide variety of 'declared areas' was entered Into FORGIS to provide as complete a set of spatial data which would be important in consideration of Forest Management and Policy. These included:

Nature Reserves - established under Forestry Legislation

Forest Reserves - established under Forestry Legislation

Protected Forest - established under Forestry Legislation

Proposed National Parks or Reserves - formally proposed by any other Government Department or Statutory Body.

Other legally established or existing protected areas - Landowner Parks, Garrick Memorial Reserve etc.

Sites of National Significance - as in the National Environment Strategy, 1993

Catchments - legally established catchments including those for:

- metered water supplies
- existing/proposed hydro-electricity
- declared irrigation areas

Flora and fauna - sites with important flora (fauna insufficiently known at the present time)

Flora **and Fauna**

An important consideration in forest management should be wildlife and biodiversity values, unfortunately these are very poorly researched in Fiji and except in a few exceptions current data is too imprecise to be a useful addition to FORGIS. For instance Fiji's birds, the most conspicuous of the nation's terrestrial wildlife, are forest derived and the majority, especially the endemics are confined to forest. However, within the forest, their distribution cannot be accurately predicted at present. There are rare species which are definitely absent from the drier western forests, but otherwise factors such as rainfall, altitude and even disturbance appear to have little predictive value.

During the Natural Forest Inventory, inventories of birds adjacent to the sample plots were made to see if any predictive relationships could be deduced. Detailed analysis still remains to be done but it is unlikely to reveal anything other than generalised distribution of Fijian forest birds. One discovery which was made during the survey is the virtual absence of the Giant Forest Honeyeater, a characteristic Fijian endemic, from the whole of Vanua Levu.

The situation for Fiji's flora is different - plants do not move !! The current state of knowledge is that we are well aware that many of Fiji's endemic species have very restricted ranges which makes them very vulnerable to ill considered forest management. However, insufficient work has been done to define ranges except for a few species such as the palms Neoveitchia storckii Gulubia microcarpa and Cyphosperma tanga

One class of obviously important and endangered plant was entered into FORGIS. All the species which are known from the type specimen (i.e. collected **only** once) or known from the type locality, have been entered into FORGIS as a one kilometre circle around the collection point. There are over 150 of these species known from **Fiji!**

FORGIS and other GIS applications are very appropriate tools for recording biodiversity data such as the distribution of endangered or significant species and, when based on more detailed research, identifying the location of similar habitats of certain species once their habitat requirements are well known. But GIS applications also have a potentially negative aspect, they can divert attention away from fundamental data collection and collation. Acquisition of advanced technology such as GIS is seen by many Departments and Donors as progress, much more so it would seem, than the collection of baseline data and the application of monitoring programs. More attention needs to be paid to fundamental data collection. It is clear, for instance, that to contribute to balanced forest management policies, Fiji's biodiversity and wildlife needs a major research initiative. The absence of any wildlife management expertise anywhere in Government or at the University at the present time is a particularly disturbing feature.

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TECHNICAL TIP

Windows for Workgroups 3.11

A feature of MS-DOS 6.2 which was not listed in the March newsletter was support for 32-bit file access under Windows for Workgroups (WFW) 3.11 when using Doublespace. This feature is not documented with MS-DOS 6.2 but only with WFW 3.11 .⊕

Application of GPS in Forestry

The Management Services Division tested a Transpak Global Positioning System (GPS) during the field work for the Inventory of Fiji's Natural Forest in 1991. At this time problems occurred [see J. Wakolo workshop paper, GIS-Inventory workshop Suva 1993]:

1. The GPS did not receive the satellite signal under forest cover. Even light forest canopy did not allow the satellite signals to penetrate. Some times the system did not even receive a signal on the edge of the forest, because there is not clear view to the horizon in all directions.
2. Most maps were based on Clarke 1880 and this spheroid is not supported by the GPS used at this time.

Three systems from Trimble Navigation were tested again on 16 March 1994 in Colo-i-Suva under light forest canopy:

1. GPS Pathfinder Basic t
2. Ensign GPS
3. Transpak (which was used before by MSD)

Now, all three systems showed the position underneath the canopy!! The GPS Pathfinder recorded more satellites (up to five) in shorter time than the others. All systems record the satellite signal based on spheroid WGS-84 and can display the geographical coordinates based on WGS-72 which is the spheroid used for the new map series of the Lands Department. An application of the GPS for forestry is now possible even with the old Transpak instrument.

Beside the reason that the satellite signal has difficulties to penetrate dense forest canopy there are other reasons that the GPS did not work before. In 1991 there were only 8 to 16 positioning satellites in space, whereas we now have the full costallation of 24. That means the chance to receive a signal from three of the satellites through a hole in the canopy is much bigger now than it was before. Three is the minimum number required to obtain a position if the altitude is known (e.g. with a barometric altitude).

The modern instruments can receive more satellites at the same time compared to the old Transpak. This might be caused by more channels (six and Transpak has only three). More important, the computing time of the new instruments is faster. While the old instrument is still calculating, the satellite has passed the hole in the canopy already. The new instruments, however, can include the signals into the calculation because of the decreased computing time.

The MSD will try to bring up an external antenna over very dense canopy using a small balloon. The results will be recorded in the GIS & RS **News.⊕**

For further *information contact Kevin McConell, Lukemine Enterprises, Phone/Fax 370858 or* Wolf *Forstreuter, MSD, Fax* 320311.

RUSSIAN SPACEBORN PHOTOGRAPHS FOR CIVIL USE

In GIS & RS No.3 from January 1994 it was mentioned that there are Russian Space borne photographs available. There are two different platforms in space, KOSMOS satellites and the permanent Russian space station MIR The satellites only have a limited time in use. When all the film is exposed, the camera and film go back to earth by parachute and the satellite disappears into space. The MIR station is permanently orbiting the earth, operators and film material are brought up and down regularly by space shuttles.

Presently, there are manly two types of cameras in use: TK350 and KVR1OOO

The images obtained by means of the TK350 camera have 10 m ground resolution. The focal length is 350 mm, nominal photo scale is 1:660,000, image size is 30 x 40 cm. One image covers the area of 200 x 300 km, and longitudinal stereoscopic overlap is 60% or 80%. Stereoscopic overlap of the TK350 camera images (maximum value of B/H ratio is 1) provides ground relief with a mean error of 7 m, which is 2-3 times better than any other existing system.

The following products are available:

1. Film Positive
2. Film Negative (in set with film positive)
3. Paper Print

One single image Film Positive costs $US 4,500

The KVR1OOO is a high resolution camera mounted on MIR as well as the COSMOS satellites. The camera provides images of 2 m resolution with coverage on the ground of 40 x 40 Km. The image size is 18 x 18 cm and the nominal photo scale is 1:220,000. The camera works with panchromatic film. The images can be enlarged to 1:1O,OOO scale without significant loss of quality. This makes it possible to create base photomaps, photoplans and other products of scale 1: 10,000 and smaller.

The following products are available:

1. Film Positive
2. Film Negative (in set with film positive)
3. Paper Print

One Film Positive cost $US 3,000.

In 1991, the German company Kayser-Trede signed a contract with the Russian space company NPO Energia to sell the Russian space images in the western world. To broaden the marketing platform Kayser-Trede signed a contract with Company for Applied Remote Sensing (GAF). Now photographs taken from MIR are available from:

Kayser-Trede GmbH.	GAF GmbH
Wolfratshauserstr. 48	Leonrodstraße 68
81379 Munich, Germany	80636 Munich, Germany
Fax No. +49-72495291	Fax No. +49-72495291

Once a customer has purchased photographs, he cannot sell them or give them away to another user. The distribution follows regulations similar to that of digital satellite data. It may be possible that different government departments can use the same photographs, if **the** government becomes the official owner.

Kayser-Trede told, that there are no photographs of Fiji available taken from MIR GAF is now investigating the archives if KOSMOS photos are accessible. The KOSMOS photographs are only sold by **GAF.⊕**

For further information contact **Wolf Forstreuter MSD. Fax: 320311.**

■ *by Mike Poidevin[1] and Osea Tuinivanua[2]*

Digital Mapping Capability at Department of Forestry, Fiji Islands

Introduction

In 1990 the Forestry Department introduced the National Code of Logging Practice (NCOLP), which by law determines how Forestry extraction operations are carried out. The preparation of a sound logging plan is a pre-requisite for the issuing of a logging licence. Part of the terms of reference for the Fiji Forest Resource Tactical Planning Project (AIDAB and GOF project), is the introduction of appropriate mapping technology to support this aim. This paper outlines the introduction of this technology into the Department.

Background

Fundamental to the development of a sound logging plan is the need for an accurate 1 :lO,OOO scale topographic base map.To date this has been met by the enlargement of the existing I:50 000 topographic base map series. As explained in the January 1994 issue of the GIS and Remote Sensing Newsletter, an article by Josua Wakalolo entitled "Scale of Maps and Aerial Photographs", it is not appropriate to simply enlarge a 1:50,000 scale map to 1 :lO,OOO and assume that one can work efficiently with it.

This problem is also appreciated by those Forestry officers whose job it is to prepare the logging plans. They find it extremely difficult to prepare suitable logging plans using the enlarged 1:50,000 scale maps.

Solution

The Fiji Forest Resource Tactical Planning Project (AnAIDAB project with the Government of Fiji), has as part of its terms of reference the supply of suitable photogrammetric equipment and an advisor to introduce a photogrammetrlc capabillty to the Forestry Department. The cartographic advisor arrlved in November 1993 and will be attached to the project for a IWO year term.

The photogrammetric equipment has now arrived and been installed in the Forestry Department. Training has commenced and it is planned to start production of l:lO,OOO scale maps in the near future.

Equipment Purchased

The following is a detailed list of mapping equipment purchased.

Stereoplotter

A Carl Zeiss stereoplotter, the Visopret 10 dig. was chosen as the most suitable instrument for this project. The Visopret is an analytical stereoplotter of medium accuracy suitable fordigitising image co-ordinates and parallaxes. The instrument is attached to a 486166 PC, and the digital data capture is directly into the Microstation CAD package.

The stereoplotter set-up is done by the program V-CAP. This software is the data management and orientation software for the system. Once set-up the user captures 3D data directly into the Microstation CAD package. Microstation was chosen as it is compatible with the FLIS data capture program.

The Visopret has zoom optics (3.5x to 15.5x) with floating marks. Film formats up to 240 x 240 mm can be set-up for observation. Negatives, diapositives or prints can be observed by the instrument.

Computers

Two computers, 486DW/66Mh.z with 28Mb RAM and 500 Mb hard disk drives are installed. One system is attached to the stereoplotter by a ZIF card allowing for 3D data capture. The other system will be an editing workstation, from which the raw data capture will be carlographically enhanced to produce the final maps.

Both systems have 17" Phillips monitors, with the edit workstation having an additional 15" monitor, allowing a dual configuration screen system. Also attached to the edit workstation is an A0 Calcomp drawing table, allowing digitising of existing maps and charts.

Software

Both computer systems have Microstation V5.0 installed. Microstation is a 3D CAD package having similar features to Autocad. It was chosen because FLIS (Fiji Land Information System) are using Microstation as their base data capture package. Compatibility between the two systems will allow data exchange without having to do translations.

The edit workstation also has a package called GWN-DTM installed. This package allows the following operations to be done directly inside Microstation :

- generate a Digital Terrain Model
- undertake profile and sectioning
- compute surface volumes and areas
- undertake slope analysis
- provides comprehensive cartographic features, such as contour smoothing, automatic contour labelling etc.

Other software installed is PAT-M, an aerotriangulation package. This is a model adjustment software package used for extending control to aerial photography without the need to provide extensive ground survey control. The error detection capability of this package is outstanding, as it readily processes aerotriangulation data, detecting any incorrect data, and highlighting it for operator interaction.

Ink-Jet Plotter

The output device is an Encad Novajet II A0 ink jet plotter. This allows a colour raster output of the finished map product.

GPS Equipment

Part of the mapping process will include the acquisition of ground control for the aerial photography. A GPS system will be purchased to undertake this work. The addition of ancillary fieldwork for the mapping will also be done using this system. The system will allow for differential GPS fixing with I-5 metre post processing accuracy.

System Design

The design of the above photogrammetric system was heavily influenced by the existing technology in place within the Management Services Division (MSD). An extensive GIS capability is in place due to the work of the Fiji-German Forestry Project. This photogrammetric system fits in well with the GIS technology and will be networked to allow data to be transferred and use of peripheral equipment.

Digital mapping equipment was chosen because PC computers are now widespread, and their applications are well advanced and proven. Interaction of data between the mapping system and GIS system will enhance the logging planning process.

Expected Outcomes

The mapping system will use existing aerial photography (nominal 1:25,000 and 1:50,000 scale) to produce base topographic maps at l:lO,OOO scale. These maps will form the basis of the logging plans to be produced in support of attaining a logging licence.

The first stage is to produce l:lO,OOO topographic maps of indigenous forest logging coupe areas. Future mapping will be undertaken for the mahogany plantation areas.

Training

Two local personnel have been seconded to the mapping side of the project. Both these people have extensive manual cartographic skills. The training will encompass the extension of these skills to include:

- Photogrammetry and stereoplotter operation for 3D data capture
- Computer skills in Microstation CAD
- Computer techniques for digital terrain modelling (DTM)
- Computer cartographic techniques
- Full training on system operation and maintenance

The development of the Windows environment in computers has streamlined the training required for computers. Operators can now concentrate on performing productive work without having to memorise computer commands and instructions. To date the training is progressing well.

Constraints

The major constraint to the project is the availability of current aerial photography. Fiji has extensive aerial photography coverage, acquired over the past twenty years.The 1:24,000 scale coverage was a flown in 1978, making it some 15 years old. This photography is suitable for the mapping of terrain relief, but outdated for its planimetric details, roads, villages, etc.

The most current 1:50,000 scale photography was done in 1986, and use of this photography is planned for the data capture of planimetric detail. It is planned that the Dept. of Lands will acquire a full 1:50,000 coverage of the Fiji Islands during 1994. When this photography becomes available, it will be used for the capture of planimetric detail.

Conclusion

The system proposed fully meets the needs of the Forestry Department to produce l:lO,OOO scale topographic maps.As a mapping system it is current technology without been at the "bleeding" edge of technology. The cost of the system is moderate when compared to what is available on the market. The stereoplotter is a medium resolution instrument that offers ease of use from both a training and operator viewpoint.

The computers and software are industry standards, that conform to what is in use throughout Fiji. The benefits of the mapping system will complement the GIS systems already in place within the Forestry Department.@

'Project Cartographer, FFRTPP, Forestry Department Fiji; 'Management Officer, MSD, Forestry Department Fiji

■ *by Osea Tuinivanua Josua Wakolo, Asesela Wata – MSD/MAFF*[1]

THE USE OF DIGITAL TERRAIN MODEL OF FIJI

The digital terrain model (DTM) of Fiji has been mentioned several times during past GIS User Meetings. But what actually is a DIM? It is not a three dimensional view of the landscape which is the idea of many people. A DTM is a raster data file containing information of altitude above sea level for every pixel (25 x 25 ml. The DTM available at MSD provides height information in feet, and positional coordinates in metres. Corrections will need to be made to translate to Fiji Map Grid.

The DTM was created by digitising the contour lines of the 1:50,000 topographic maps. This work was done in Germany and the DTM was sent to Fiji where it is available at MSD. The contour lines were digitised from the old topographic map series, however, that does not mean that the DTM is outdated. The topography does not change that fast, so the DTM can be considered up to date. In 500 years time we may have to produce another one!

The DTM is available for the following islands: Viti Levu, Vanua Levu, Kadavu and Taveuni. The DTM can be used to produce several information layers for GIS analysis of the land cover:

1. slope map
2. aspect map
3. contour maps
4. shaded relief images
5. 3D perspective images

[1]*Presented at* ***GIS User*** *Meeting.* ***12 April 1994***

Slope Map

A slope map is a GIS layer containing the information of the steepness of the terrain for every pixel. This is the change of elevation over a given distance. The ERDAS program SLOPE analyses a 3 x 3 pixel window of the DTM and calculates the difference in altitude to the neighbour pixels. The result is then stored in a new layer providing the information steepness in degrees or percent.

MSD used the slope map for its Forest Function Analysis. The slope layer in degrees therefore was recoded into slope classes. All pixels indicating a steepness between 0 - 16° became the class value 1, those indicating a slope between 17 - 28° became the value 2, value 3 **indicated slope** between 29 - 32° and 4, a steepness of over 32°. The slope layer in degrees and the layer 'slope classes" are also available at MSD.

Aspect Map

For some analysis the user wants to know which direction a hill side faces. Eg. In arid areas, plantations should not be established on a hill side facing the sun. So, the user wants to know all areas with a direction not facing North. Therefore an aspect map can be calculated from the DTM. Such a layer contains for every pixel the facing of the slope in degrees. A 360° aspect indicates an east facing slope while due north is 90°. This layer can be automatically grouped into eight classes north, north east, east, etc.... There has been no use of aspect maps in forestry to date.

contour Map

A contour map shows the changes in terrain by lines that connect points of equal elevation. Nearly every topographic map shows contour lines. The contour map layer of a raster data file is slightly different. Pixels that represent a contour line are coded with the elevation of the contour line. All other pixels are coded zero. Such a layer can be produced by a ERDAS program and can be later converted to a vector data file if necessary,

Shaded Relief Image

A shaded relief map provides an illustration ofvariations in elevation. Based on a user-specified position of the sun, areas that would be in sunlight are highlighted and areas that would be in a shadow are shaded. Shaded relief maps are generated from an elevation surface, alone or in combination with a GIS file draped over the terrain.

In calculating relief, the software compares the user-specified sun position and angle with the angle each pixel faces. Each pixel is assigned a value between -1 and +1 to indicate the amount of light reflectance at that pixel.

3D Respective View Images

A 3D (three dimensional) perspective view is a visual simulation of terrain. Based on the position fmm which the view is calculated, it is possible to make the graphics look like the viewer is standing in or hovering above the landscape.

There is no practical forest application of a 3D image, however, visitors like it at MSD!

CONTACTS

Organisations within Fiji who receive and provide contributions to this newsletter:

ORGANISTATION, FAX
Delegation of the Commission of the European Community, 300370
Department of Energy, 370039
Department of Environment, 303515
Department of Town and Country Planning, 303515
Embassy of the Republic of Marshall Islands
Environmental Consuftings Fiji Ltd, 370012
Fiji Forest Industries Ltd, 613066
Fiji Pine, 661764
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Ministry of Natural Resources, Geological Survey Division. Solomon Islands
Department of Agriculture, Tonga
Ministry of Fisheries. Tonga
Ministry of Foreign Affairs, Tonga
Ministry of Lands, *Survey* and Natural Resources, Tonga
Department of Lands & Survey, Tuvalu
Meteorological Office, Tuvalu
Ministry of Natural Resources, Tuvalu
Office of the Prime Minister, Tuvalu
Public Works Department, Tuvalu
EOSAT, USA
United States Forestry Service, USA
Department of Geology, Mines and Water Resources, Vanuatu
Department of Forestry. Vanuatu
Lands and Survey Department, Vanuatu
Ministry of Foreign Affairs, External Trade & Immigration. Vanuatu
Apia Observatory, Western Samoa
Department of Agriculture Forests and Fisheries. Western Samoa
Department of Lands, Surveys and Environment, Western Samoa
Ministry of Foreign Affairs, Western Samoa
South Pacific Regional Environment Programme (SPREP), Western Samoa

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PRIVATE MAIL BAG, GPO
SUVA, FIJI
Attention: Les Allinson
Tel: 381377 Fax: 370040

Or

MANAGEMENT SERVICES DIVISION
FORESTRY DEPARTMENT
PO BOX 3890, SAMABULA
SUVA. FIJI
Attention: Wolf Forstreuter
Tel: 322635 Fax: 329311

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