Highlights

- **GIS for Offshore Limits and Zones Setting the Framework for GIS**
- **The Pacific Islands GIS Community**

Highlights

- **GIS Activities at MRD, Fiji**
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Fiji South Pacific and GIS/RS news

The Newsletter of the GIS/Remote Sensing User Forums
Issue 99/02
July, 1999

The second Newsletter the year....

Interesting articles arrived and we did not want to wait

Welcome to the second edition of the newsletter for 1999 which was a joint effort of all editors from SOPAC and USP.

This newsletter covers the topics, coral reef and coastline monitoring in several articles. Ramesh Bhai (Lands Department Fiji) reports the benefits of Landsat satellite images for reef mapping. Xue Chunting and Robert Smith (SOPAC) report from their activities in Kiribati and Cook Islands.

The Mineral Resources Department in Fiji hosted the GIS and Remote Sensing user meeting in May and presented their recent activities, which are reflected in several articles in this newsletter.

An important article arrived from Grant Boyes (Forum Fisheries Agency), which again highlights the needs for GIS employment for off shore areas.

The Management Services Division of Forestry Department Fiji relocated their GPS base station antenna, which is of major importance. The new antenna position on top of an 25m high antenna mast has not only the potential to have an 360° free horizontal view but it is also combined with a radio communication antenna, which could enable a real time differential correction.

Image backdrop by employing rectified Satellite image or corrected aerial photographs was discussed in several newsletters. This newsletter shows how to use and how to produce backdrop out of topographical maps provided by the Lands Department Fiji.

During the regional information technology meeting a Pacific section of the Internet Society was formed, which will be another step for the development of information technology in the Pacific.

From the Tonga Electrical Power Board arrived another report about ongoing GIS activities, about the power utilities in Fiji and Solomon Islands will be reported in the next issue of the newsletter.

SOPAC's web site is visited by an increasing number of people, the GIS Metadata project will start to provide a new form of information about stored GIS data, where Fiji Forestry and Mineral Resources Department will join soon.

Available earial photographs at SOPAC can be displayed from the web site in form of a quick look, which avoids time consuming phone or fax comunication.

Cheers, Wolf, James, Les

Download your coloured version of the Newsletter from SOPAC's web

ISSN 1562-4250

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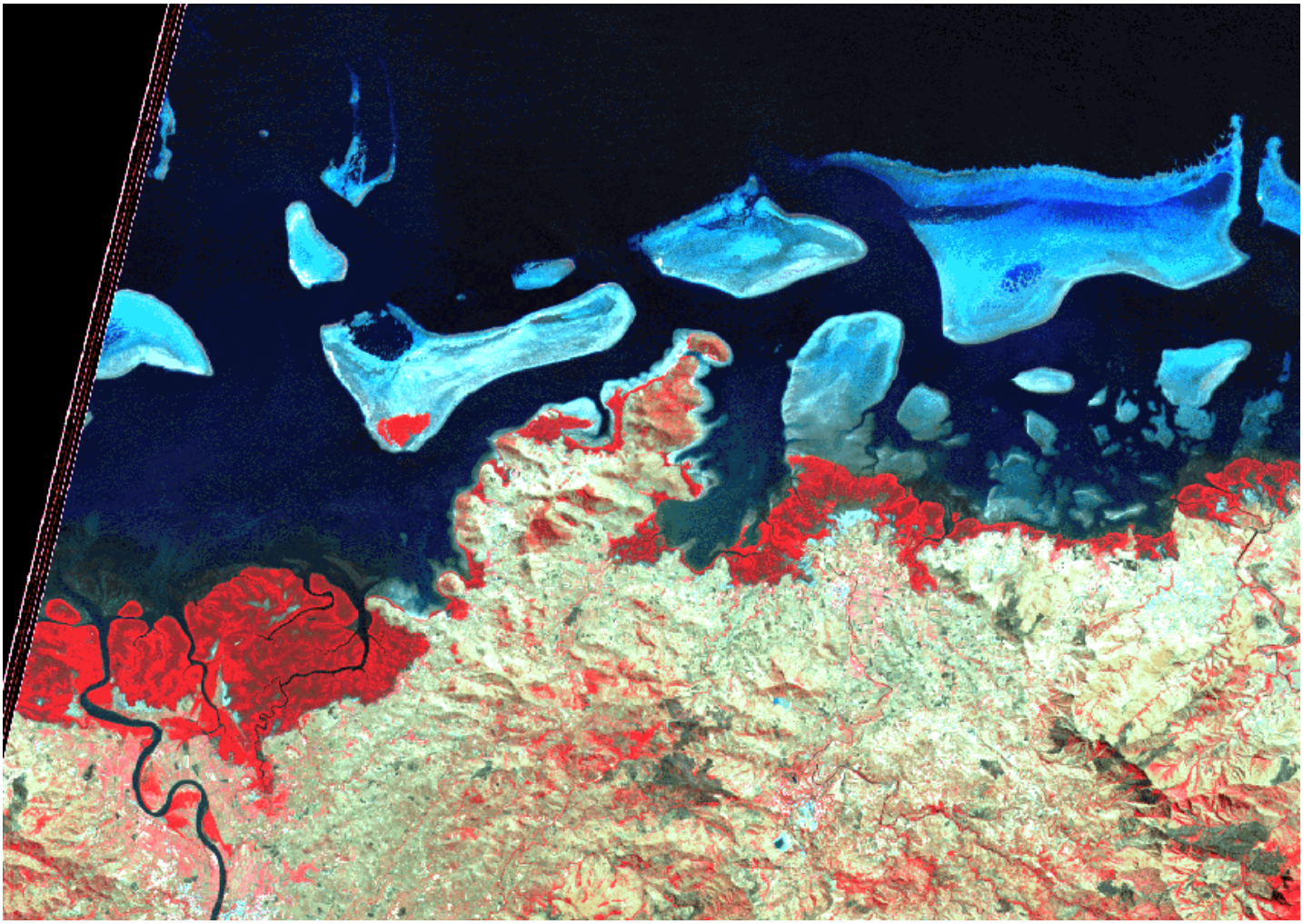
Latest Satellite Image of Fiji



The image is cut out of SPOT scene 435/385 and geo-reference to 1:50,000 map sheet M26 Ba area north of Viti Levu, Fiji. The scene was recorded 6 August 1998 when most of the vegetation was effected by drought.

The Pacific Island Regional GIS Community

Moving ahead – getting stronger

James Britton, USP

Community is a concept that comes easily to those who live in the Pacific Island States. Community is defined around the concepts of common characteristics, interests, activities, identity or geography. Community also underscores the idea of being aware of what others do in the community and the concepts of helping and sharing. The importance of community in Pacific culture is remarkable, especially to those who come from "western" societies outside the region.

Given this, the term "community" is a good one to use to describe the variety of people who plan, implement and use GIS in the Pacific Island Region. A term that more accurately describes the current state of affairs than terms used elsewhere, such as "industry", "discipline" or "profession". It can be suggested that the development and use of GIS, Remote Sensing, Cartography and other related technologies is relatively low or perhaps in the early stages within the region. Europe, North America, Australia and New Zealand, our usual sources of modernisation, have much more advanced and widespread systems in place to handle geographic information in all its forms.

Such blanket statement, however, overlooks many of the advances that have been made in developing what is referred to here as The Pacific Island Regional GIS Community. A closer examination reveals that there is good evidence that such a cohesive community exists and that the work that is going on in the region is advancing quite well. A survey of various events and developments that have taken place across the region over the past year and that are planned for the rest of 1999 shows a strong emergent regionally based GIS community. One that is driven by regional interests and is taking more pride in what is being done here and not just what is being brought in from outside.

There is increasing awareness of the Region as a stronger GIS presence. In March, Pacific Island State representatives to the Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP) met together in Suva for a one-week workshop to examine the issue of establishing basic geo-information databases. This meeting brought together the heads of the national basic mapping organisations across the Region. One of the key resolutions of this meeting was the recognition of the unique aspects of GIS within the Pacific Region. As a result of deliberations, it was decided to form a Pacific Regional Secretariat for GIS Infrastructure to act as a focus for work across the region in this area. The Secretariat, to be hosted by SOPAC, will act as a co-ordinator and voice for GIS interests within the Pacific Island governments.

GIS users are more aware of their increasing activity. In December of 1999, the Fiji GIS/Remote Sensing User Forum held its first Annual User Conference which saw nearly one hundred GIS users and interested individuals come together at The University of the South Pacific in Suva to discuss advances, problems, and solutions within their own organisations. In 1999 the invitation has been extended to GIS personnel across the region. What is notable about this conference is that this is not a workshop where outside people come in to tell regional people what to do. It is one where local expertise is being used to help others solve problems and advance forward. Meeting as a group promotes the idea of purpose, identity and professionalism for the Regional GIS community. The establishment of more local User Groups, such as in the Solomon Islands and New Caledonia, echo this increased desire to share ideas and methods.

GIS awareness is spreading through the region. Nearly every country in the Region has conducted basic GIS workshops, most recently the SOPAC run workshops in Niue and Tuvalu. Registrations for GIS courses at The University of the South Pacific are at an all time high. Following on from the well received environmental GIS workshops run by SOPAC in Pohnpei, further EPA workshops are planned, notably in Kosrae State.

We are seeing GIS and Remote Sensing techniques applied in a wider range of applications. Beyond the established applications of GIS, the past year has seen GIS & RS used by regional organisations for drought impact studies, reef mapping, minerals prospecting and international boundary establishment. While these applications have been explored in the region before, what is notable is that departments within Island State governments and organisations are now carrying out these activities.

A wider range of GIS, Remote Sensing, and Cartographic methods are being used within the Region. The Fiji Lands and Surveys department is completing investigations to move to a totally computer

assisted Cartographic department. Negotiations are underway for the collection of low altitude Radar data under the PACRIM program.

The increasing level of local participation and expertise is clear. Individuals at the local level are initiating and implementing more and more GIS projects. We have seen new locally driven projects initiated within the land management, natural resources, and utility sectors. An example of such a project is the "green lumber" forestry project in Fiji. This project is designed to build a GIS system that will ultimately plan and monitor the harvesting, processing and shipping of sustainable yield forest products to outside markets. Now, while it is true that not all of these projects are completed without outside help, what is notable is that the projects are now locally initiated and local GIS staff are completing a larger portion of the work.

There is an increasing awareness of "doing it right". In the past, as with any new technology or method, the emphasis has been on getting some kind of result and not on a critical look at the methods being used. Projects have been run that may not have been as efficient or accurate as may have been desired or have produced reusable data products or high quality documentation. The increasing interest in proper techniques shows the maturing of the Regional GIS User Community. An example of this is the metadata projects at the Mineral Resources Department and Fiji Land Information System offices in Fiji and the integrated metadata management system under development at SOPAC. The expansion of GIS course offerings at The University of the South Pacific into more advanced level work and the expanding range of workshop offerings available through SOPAC further show the desire for local users to learn and use more advanced techniques.

Collectively, these events and trends show that the use of GIS and related technologies is increasing across the region. What is perhaps more important is that they show that GIS organisations and users are becoming more sophisticated in their activities and attitudes. The other key trend is the emergence of a collective Regional GIS User Community. A community that recognises the unique needs of the Region and the local realities that need to be faced when looking at future developments in GIS within the Region. Most importantly, it is a community that is becoming more and more locally driven and locally aware

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Landsat Imagery Assists in Reef Mapping

Ramesh Bhai
Lands Department, Fiji

The subjective stereo-model as observed under a stereoscope was prepared and mapped for 1:50,000 scale. The standard 1:50,000 scale sheet Naviti (numbered L25) is covered to 80% by scattered reefs. After plotting the first map produced by aerial photo interpretation, it was difficult to determine whether some submerged reefs were missed out. Knowing the availability of Landsat TM images at Management Services Division of the Forestry Fiji, Dr. Wolf Forstreuter was requested for assistant.

He rectified a Landsat TM scene recorded at 15 May 1991 of the Bligh Waters using ground control points located on islands in the Yasawa Group and in the western part of Viti Levu. The printed images fit exactly on the Lands Department 1:50,000 map sheet coverage. The image covering the sheet L25 was brought to the Air Survey Office and checked against the map, which was prepared for this sheet employing photo analysis. The map was overlaid onto the satellite image and it was noted that a lot of small reefs, which could not be seen on a black and white photographs, were clearly seen on this imagery. These reefs were outlined with pencil and thereafter the aerial

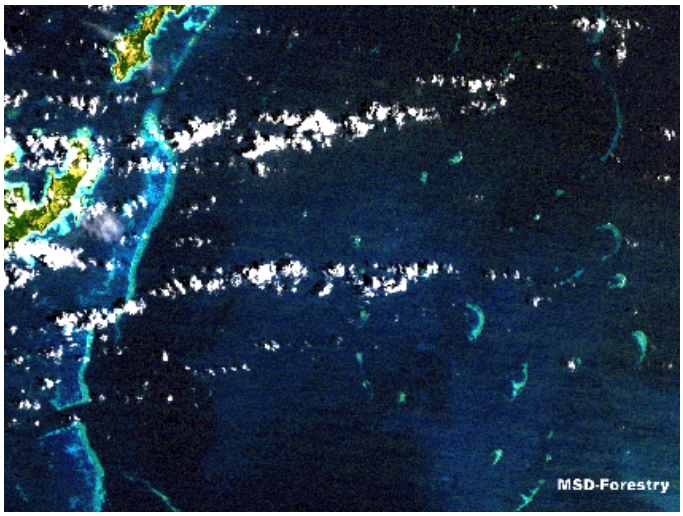


Figure 1: *Landsat TM image covering 1:50,000 map sheet L25 40 x 30km. A part of the Yasawa Group is visible in the upper left corner.*

photographs were reset for mapping. The reefs, which were not visible at first, were acquired using Landsat imagery. This assisted the Department to complete the map without missing any reefs.

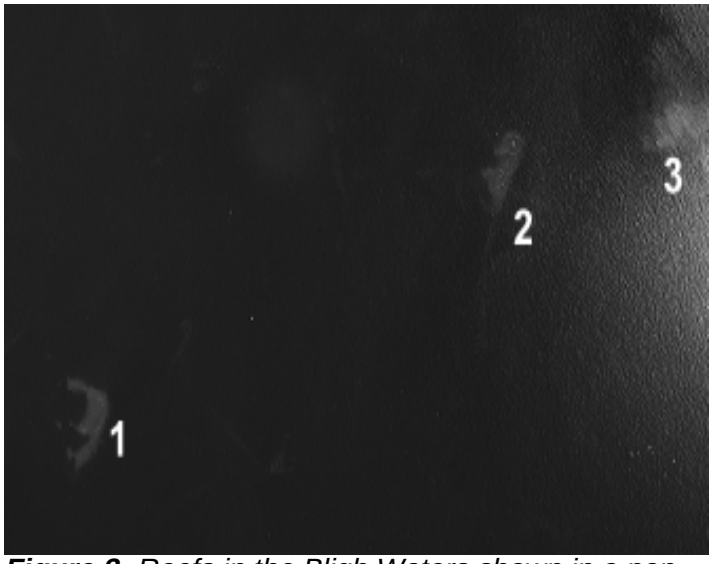


Figure 2: *Reefs in the Bligh Waters shown in a panchromatic aerial photographs. The blue part of the spectrum is not included.*

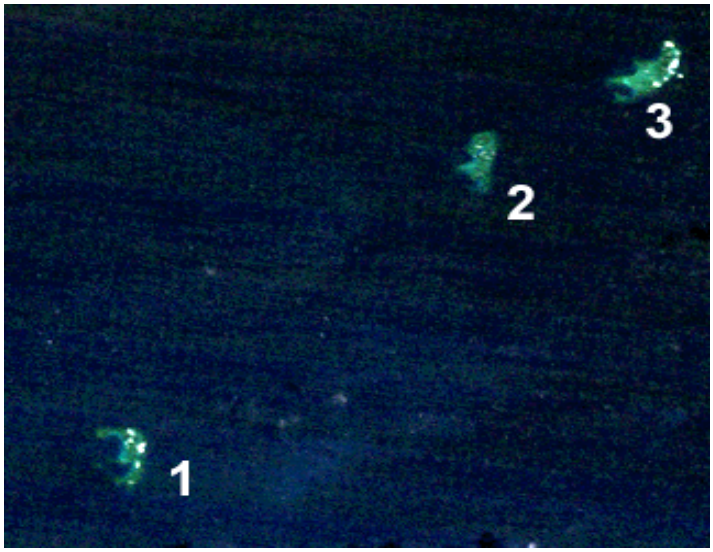


Figure 3: *Reefs in the Bligh Waters shown in a Landsat TM image. The visual bands 1, 2, 3 refelect the blue part of the spectrum important for reef mapping.*

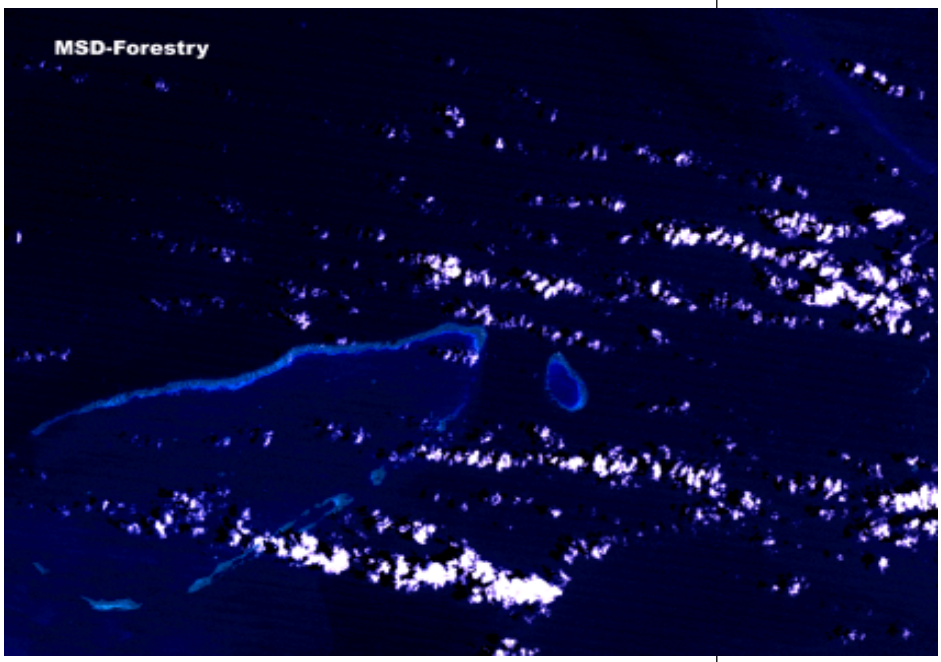


Figure 4: *Landsat image fitting exactly on 1:50,000 map sheet M25. This image is cut out of a geometrically corrected scene covering 175 x 180 km. All reefs have the geographic correct position and can be mapped directly from the image.*

Remarks by Wolf:

Landsat satellite images have two advantages compared with aerial photographs or SPOT images:

1) They cover a large area 170 x 180km in comparison to SPOT images (60 x 60km) or aerial photographs (a few square km only). In such a large area of nearly 1300 square km a sufficient number of islands with known geographical location will be shown, where ground control points for the image rectification can be selected. After geometric correction the Landsat scene is cut to images covering a 1:50,000 map sheet each showing the reefs in correct geographical position.

2) The reason for the improved visibility of reefs on Landsat TM images is the difference of the spectral coverage. The Landsat TM sensor records the blue light (optimum at 470 nm), which penetrates water better than the green or red portion of the light. A camera for taking panchromatic aerial photographs is equipped with a filter, which provides some positive effects, however, it cuts the blue light and even part of the green light. Only very shallow reefs can be recorded. The multispectral SPOT sensor does not cover the blue portion of the spectrum either.

OFFSHORE LIMITS & ZONES

setting the framework for a GIS

Grant Boyes, FFA

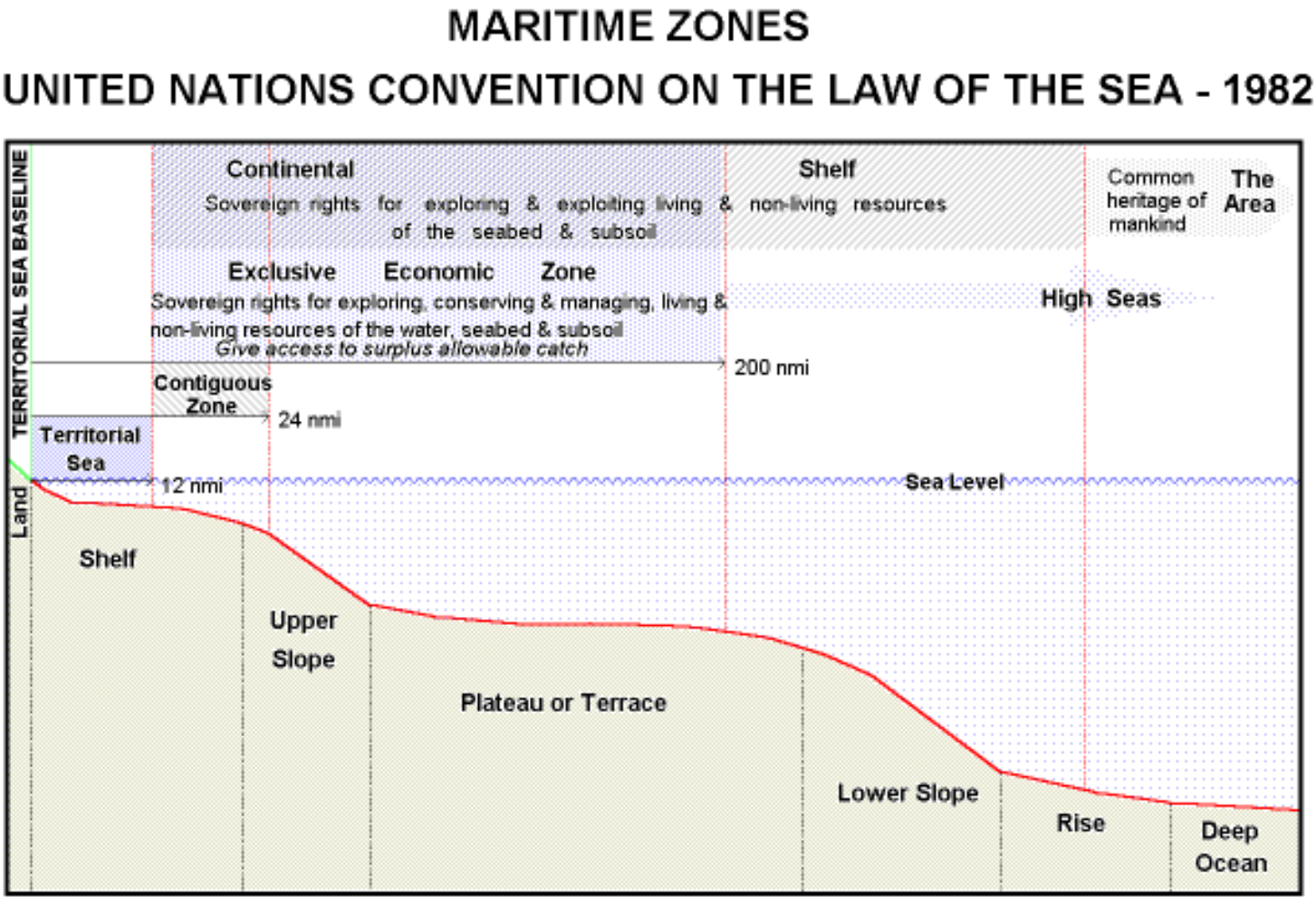
This article gives a very brief overview on a series of issues that in themselves could either be a separate article, or series of articles in their own right, in fact for some of them academics have managed whole books on the topic.

Background

In terms of the implementation of the United Nations Convention on the Law of the Sea, 1982 (UNCLOS), there are several different sources of information that can form framework for information for a GIS, either at a regional or country level. The basic layers after the mapping background are (see also Fig. below):

- the territorial sea baseline;
- the outer limit of the territorial sea (12 nautical miles);
- the outer limit of the contiguous zone (from 12 nautical miles to 24 nautical miles);
- the outer limit of the exclusive economic zone (EEZ) (from 12 nautical miles to 200 nautical miles); and,
- where applicable the outer limit of the continental shelf as defined by Articles of UNCLOS.

One other layer of information that is required is that of maritime boundaries between adjacent States. This situation occurs when there is an overlap of any of the last four mentioned limits above.
These limits and zones provide the basic framework for countries in the management of their adjacent offshore area. It is not necessary for countries to be a party to UNCLOS in order to claim these zones, as they now form part of what is commonly called customary international law. The coastal State has different levels of jurisdictional power over each zone.



These zones are not resource specific, except for the contiguous zone which does not relate to resources at all. This is a zone which is next to and beyond the territorial sea in which a coastal State has limited powers of enforcement of customs, monetary, sanitary and immigration laws.

For each of the offshore zones, with the exception of the continental shelf where it extends beyond the outer limit of the EEZ, the territorial sea baseline is the feature which determines the location of the outer limit of each. In respect of regional applications of the various zones it is important that there is an absolute relationship of one area to another, both within the country and with neighbouring States.

To this end there has been a project at the Forum Fisheries Agency (FFA) for the past eight years to provide advice and assistance to the fourteen Pacific Island States that are members of the FFA, in respect of their offshore zones and limits, including maritime boundaries with neighbouring countries. One aspect of this project has been to determine the territorial sea baselines for all States in terms of the World Geodetic System 1984 (WGS 84).

Fish were the catalyst for the project being located at FFA but with the need for coastal States to fully implement the provisions of UNCLOS, they are now somewhat incidental to the process.

Besides a coastal State's need to know the precise extent of their offshore limits for all sorts of reasons, one important aspect in relation to the management of fish stocks in the region is the monitoring, control and surveillance of fishing activity. In order to do this effectively FFA has developed a vessel monitoring system (VMS) which is based around Inmarsat and GPS. This has been one of the main reasons for the adoption of WGS 84 as the datum, as it is generally accepted as the default datum of the GPS receivers. Therefore, there is no need to go through any other process to make sure that reported sighting or infringement may not be precisely where it claimed to be.

Problems Encountered in Getting the Right Framework

Naturally the greatest problem faced in getting a common mapping framework in the region was the variety of maps, charts, projections and datums. Not to mention the lack of a single data source from which to determine the territorial sea baseline.

Fortunately, a number of countries had medium scale orthophoto maps and subsequently Doppler satellite observations were made on a number of the survey control points used for these maps. This provided a direct relationship between the original mapping datum and WGS 72. Others have standard topographic maps which have subsequently had observation of original control points carried out in terms of WGS 84. While in some areas there are no modern day charts or maps for which the original control can be re-observed.

As this has been a practical exercise in getting what amounts to map control accuracy, rather than geodetic control accuracy, it has been possible to get a framework for the areas where control points have been re-observed to a reasonable level of accuracy. Especially considering that the aim was to eliminate shifts that in some cases were in the order of kilometres rather than metres from the original mapping datum.

For the remainder of the countries where it was not possible to re-observe original survey marks to adjust to WGS 84, observation have been made using differential GPS to survey the reef edges of all islands and atolls. In the main this work has been through the Mircronesian countries. It has been possible, in most cases, to use high precision, adjusted survey marks that were observed in terms of the North American Datum 1983 (NAD 83). For all practical purposes there is virtual no difference between NAD 83 and WGS 84. A report by the Office of the National Geodetic Survey, National Oceanic and Atmospheric Administration (Docket No. 950728196-5196-01) states in part:

> "*Both NAD 83 and WGS 84 were originally defined (in words) to be geocentric and oriented as the Bureau International de l'Heure (BIH) Terrestrial System. In principle, the three-dimensional coordinates of a single physical point should therefore be the same in both NAD 83 and WGS 84 systems; in practice, small differences are sometimes found. The original intent was that both systems would use the Geodetic Reference System of 1980 (GRS 80) as a reference ellipsoid. As it happened, the WGS 84 ellipsoid differs very slightly from GRS 80. the difference is 0.0001 metres in the semi-minor axis.*"

With respect to this survey work, Marshall Islands is the only country left where extensive field work remains to be done.

Application of the Various Zones and Limits

As stated above, fish were the catalyst for this project but the zones (with the exception of the contiguous zone) are not resource specific. Regardless of what offshore natural resources there are, a coastal State needs to precisely define and delimit the various zones it is entitled to claim under the provisions of UNCLOS.

There is generally a misconception that the EEZ, because it *includes* the water column, is the domain of fish, while the continental shelf, because it refers only to the seabed and subsoil, is the domain of minerals. Both areas include both living and non-living natural resources.

In essence the VMS developed by FFA is a working GIS based around a framework of the various offshore zones. While it presently merely gathers the name and location of vessels that have an appropriate automatic locator installed, there is the potential to enhance the system to gather other attributes, such as catch statistics in near real-time. For the moment however, this information is obtained in other ways and can later be related back to the vessel and location.

While presently geared to fishing vessels and the vessels that service them, such a system will work just as well on other vessels being used for other activities. If it were to be use in conjunction with other remotely sensed data an inventory of vessels not fitted with locators could be built up over time and surveillance activities would become more effective.

Inventories of resources can be built up and ascribed to specific locations within the various zones. In the case of FFA, the VMS is an integration of a positioning system (GPS using coordinates expressed in terms of WGS 84); and communication system (initially Inmarsat to and Earth station, then by either Internet or telephone); a mapping/GIS interface (utilising MapInfo); all linked to and Oracle database.

In respect to other resources, the zones are essential to the day to day management of their exploration, development and exploitation. In the case of hydrocarbons where a prospective structure is either in the vicinity of or straddling a particular boundary - be it a boundary between neighbouring States, or where a particular State is comprised of several provinces, a boundary between the provinces - revenue sharing and royalties accruing from the resource can be apportioned in an appropriate manner.

IN CONCLUSION

Settlement of maritime boundaries between neighboring States and the accurate geographic definition and delineation of the various offshore zones, helps regional stability and gives certainty to the ownership and management of marine resources. In particular settled maritime boundaries and well defined zones, provide a firm foundation for bilateral and regional resource management arrangements also for effective surveillance and enforcement.

Absence of an agreed maritime boundary and well defined zones, which are both binding at international law, and reflected in domestic legislation, may give rise to difficulties in enforcement. It may lead to a dispute with neighbouring countries over the ownership of resources either in the shorter or the longer term. The absence of established boundaries may also give rise to disputes, for example, with distant water fishing nations (DWFN) or, resource developers in the case of deep seabed minerals.

Within the region covered by member countries of both FFA and SOPAC there are 45 locations where overlapping zones make it necessary for a maritime boundary to be negotiated and put in place. Of these:

- 10 have been negotiated and are now in force;
- 5 have been agreed to at officials level but are not in force;
- 4 are in the process of being negotiated;
- for 24 the negotiation process is yet to start; and,
- 5 have the potential for a boundary to be negotiated in terms of continental shelf beyond the outer limit of the EEZ, 3 of these would be an extension to and existing maritime boundary in respect of EEZ and, 2 would be in an area where there is no overlapping EEZ involved.

For some of the boundaries yet to be negotiated, because of special circumstances that apply to the situation, the negotiation process could be extremely long. By way of example, even for what on the surface appear to be a simple and straight forward negotiation, the process can take up to 6 to 8 years to be completed and the boundary put in place. The speed of the process depends on the political will of the coastal States concerned to reach an agreement. It is a sovereign issue for those States and third parties cannot dictate the speed at which negotiations proceed. A final note on this subject to clarify some misunderstandings.

On the issue of continental shelf that extends beyond the outer limit of the EEZ. Countries that are parties to UNCLOS and who ratify or accede to it, have ten years from the date of ratification or accession within which to submit a claim for an extended continental shelf. However, there is no such limitation on the period of time in relation to negotiating a maritime seabed boundary where the extended continental of adjacent States overlap.

In terms of defining and delineating the extended continental shelf, this is a prime example of an issue that could be a separate article, or articles, in its own right.

New Coastal Photographs for Rarotonga

Xue Chungting, SOPAC

The *Strategy for Foreshore Protection and Development in Rarotonga and Aitutaki* project in the Cook Islands has produced a new composite digital photograph of the Rarotonga coastline. This data product was produced as part of a SOPAC work programme, project number CK99.00, funded by the Government of the people's Republic of China. Based on source aerial photography taken in May of last year by the University of Otago, New Zealand, the composite image was produced using ERDAS software.

The composite image (show below) shows the coastal morphology, topography of the reef flat, and current direction of sediment movement in the lagoon of the island. The project aims to establish a coastal monitoring network at Rarotonga. This image will serve as a major component of that network and can be used for future shoreline study, monitoring, coastal land use planning and as basic information of coastal engineering designing.

GPS Base Station Relocated at Fiji Forestry Department

Joni Duikoro, MSD-Forestry

Fiji Forestry Department's Management Services Division (MSD-Forestry) is responsible for forest inventory and monitoring that requires accurate survey using differential GPS. The original GPS base station, installed in 1994, was the first of these facilities in Fiji. It had to be relocated due to problems encountered with securing the data capture.

Figure 1: *The antenna mast is 25m in height to garantee a free view to the horizon above the trees.*

Relocation of the base station required moving the antenna to an optimal location on a hill where it had an unobstructed view of the horizon. It inappropriate to cut trees and the solution was to mount the antenna on a 25m high pole built out of an 18m x 150mm dia, a 6m x 75mm dia and a 1m x 25mm dia galvanised pipes reinforced with steel cables (see figure 1). The total cost of the antenna mount was FJD 3,900.

Forestry Management also decided to invest in a radio telephone antenna fitted on the same pole to allow communications with field staff on the status of the base station.

Following the relocation of the antenna, a new survey of the position was necessary. MSD-Forestry could not justify the cost of FJD 3,000 for a conventional survey by the Lands Department and an alternative solution was used. SOPAC employed its Trimble 4600LS system to provide a cm accuracy survey after differential correction. During this survey, the 4600LS base station was placed on trigonometric points with known co-ordinates and the other unit serving as rover was placed on top of the antenna pole.

Figure 2: *Below the GPS antenna a radio communication antenna is fixed on the pole*

The antenna has following position co-ordinates: 18º04'29.6291"S 178º29'58.5550"E and 123.18m above ellipsoid, which has about 6cm accuracy. These figures are essential for all users of the base station.

Figure 3: *To avoid high costs of a conventional survey the antenna position was determined by using the location of trigonometric points. The picture shows Litea Biukoto (SOPAC) with Valimani Latilevu and Joai Duikovo (MSD-Forestry) during the field work.*

The laptop computer that ran the base station software was replaced by a robust desktop linked to the local area network. From there the data will be transferred to the MSD-Forestry server and then by telephone lines to SOPAC where the data necessary for differential correction will be accessible on SOPAC's web page.

This data will be available to all users with internet access while SOPAC requires the same data for online differential correction while undertaking swath mapping of nearshore areas. To avoid purchasing another base station in Fiji, a radio link is planned that is for transferring the data to a relay station for subsequent broadcast throughout Fiji. This will be the first GPS base station in the South Pacific that provides country wide online data correction.

Mining Tenement Boundaries as a GIS Layer

Ian Fong, MRD Fiji

Among its key roles, the Mineral Resources Department *on the behalf of the people of Fiji*, administers land for mineral exploration and development. The Department functions as the rights administrators of land for such natural resource development. This involves guiding companies and explorers through the legal process involved from

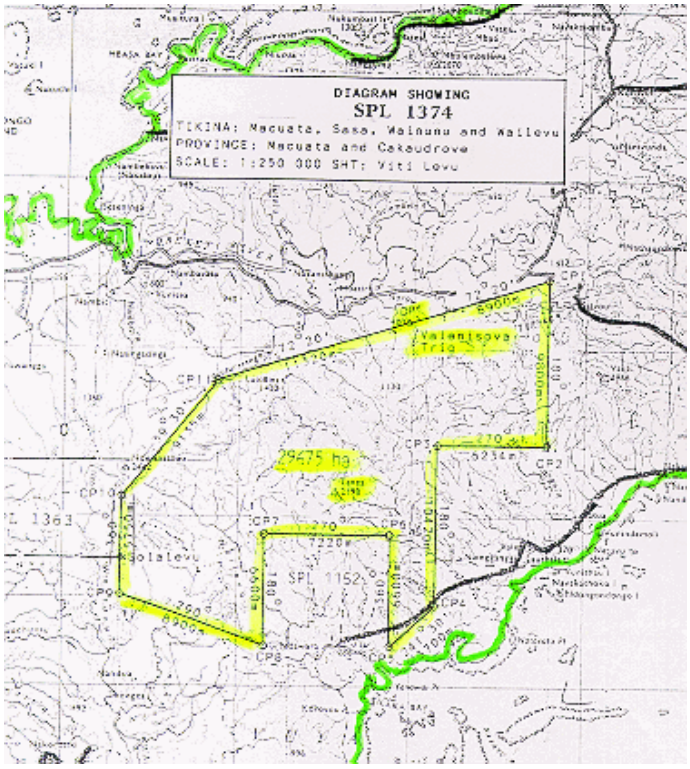


Figure 1: *Map attached to minig permission*

application for a license to approaching landowners for permission. The final product is a legal document giving the rights to the applicant to prospect or mine certain minerals in a location as marked by a map. *An example of such a map is shown in figure1:*

This is known as a ***prospecting license or mining lease*** (if it is for mining).

As with all land administration, there are 3 key points to note :

- rights of landowners must be given prior to any work on the land
- geographical boundaries must be clearly mapped for the area approved
- maps of all areas issued must be made available to the public

The GIS enters the scene at the mapping stage since land boundaries are spatial in nature and geographically referenced. The projection system used in our GIS is the Fiji Map Grid. Boundary points are then determined in FMG metres. The method used to capture the shape and magnitude of these boundaries is summarised as follows:

1. A geographical reference point visible on the ground must be identified and selected as appropriate. In prospecting licenses, these are the trigonometrical stations as established by Govt. surveyors from the Lands Dept.
2. The location of this point in space is determined – either by triangulation or conversion of geographical grid coordinates to the Fiji Map Grid.
3. The distances and bearings (direction) to the nodes (corner posts/datum posts) are entered for subsequent point locations. [*see figure 2*]

Figure 2

4. The data is processed based upon mathematical triangulation to locate the next point in FMG coordinates.
5. These points are then used to form the shape of the licensed area.
6. Information/ attribute data is then assigned to each shape as an object in the GIS layer. At this stage the inventorial aspects of the GIS is completed.

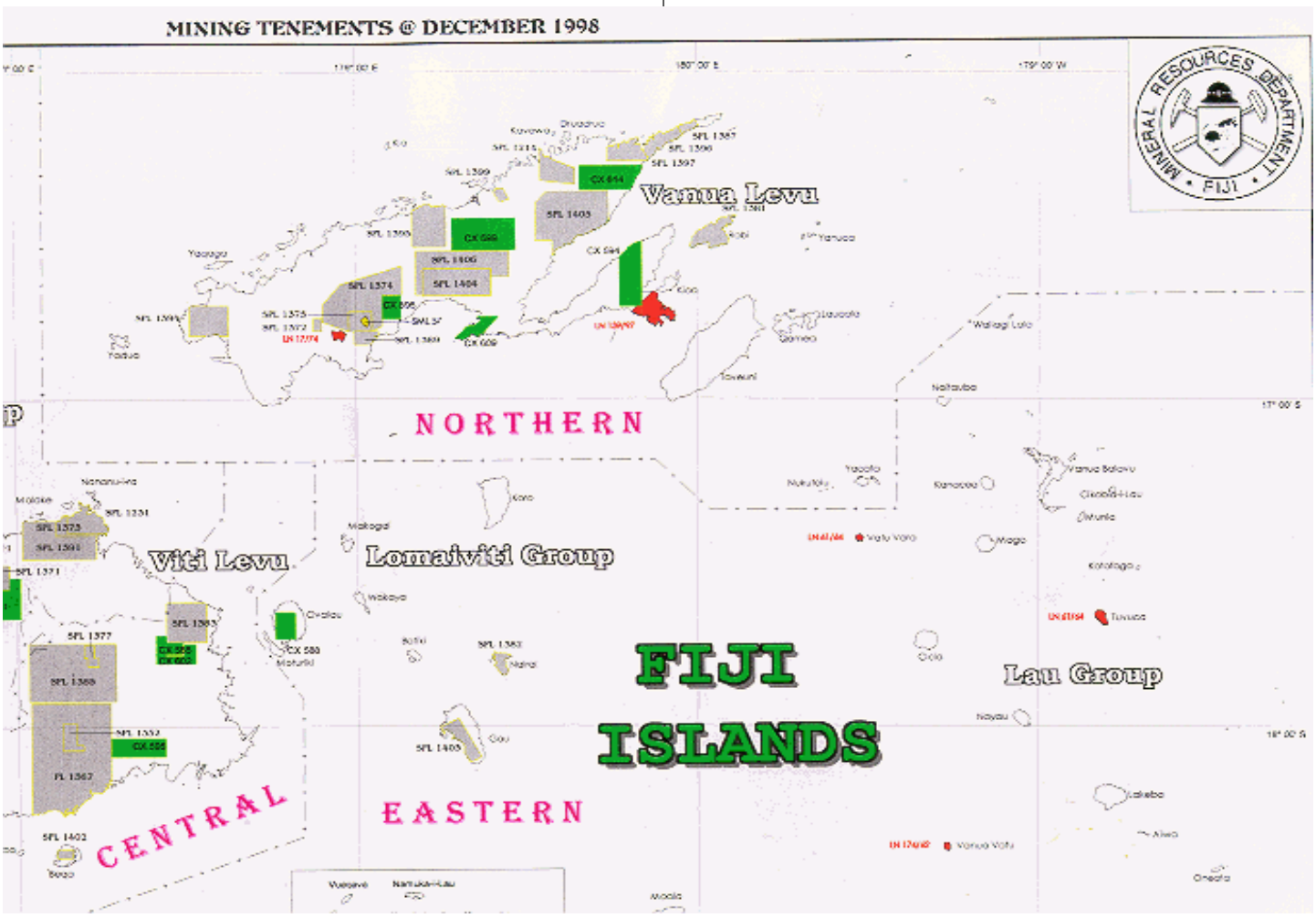
Among a product generated from this GIS layer is a Mining Tenement Map, of which *a sample is shown in figure 3 :*

Customers of such datasets include exploration and mining companies, or entrepreneurial individuals hoping to strike it lucky by gold digging. The Department itself and functional units use such data for their geological exercises. After all, the most comprehensive information on geology and earth science is best located by identifying areas that have been investigated before. Sister departments such as the Department of Mines in Australia or Australian Geological Survey Organisation have an interest in minerally prospective areas for comparative analysis. Among other users are academics who need information for projects on land use, resource economics or environmental studies to name a few. The media (local & international), use maps for reference in articles related to resource development. And lastly, the general public who may wish to know whether there is gold in their backyard or not. Or whether a mine may open up nearby.

Our data is available as an image in 2 formats:

- *hard-copy/paper* - upon request at Department or through Mineral Digest subscription
- *digital* – as a raster image through the MRD web-site at http://www.mrd.gov.fj

These maps are usually updated on a quarterly basis but requests for latest versions can be catered for.



Aerial Photograph Preview on SOPAC's Web Page

Anna Elaisa, SOPAC

The SOPAC Aerial Photograph database was set up earlier this year to catalogue all aerial photographs held at SOPAC for its member countries. The inclusion of a snapshot facility in the database enabled users to visualise and/or work with aerial shots of the various sections of the different countries.

Each time aerial photo sets are entered into the database the photos for that particular entry need to be scanned, resized and packaged as snapshots of JPEG images (see Fig 1).

Each snapshot details the Aerial Set ID, the run numbers and longitude and latitude (if available from the flight lines).

The database is also directly linked to the SOPAC website to allow SOPAC users and visitors to view images from its web pages http://www.sopac.org.fj/Databases/default.htm

The main objective of this exercise was not only to provide an online service of catalogued SOPAC aerial data but also as part of SOPAC's advancement into GIS, to allow users to be able to correct/rectify the images and stitch portions of these images of countries of their particular interest.

Figure 1: *On the left is the database entry with the packaged snap-shots. The picture below is the actual aerial shot of one of the images.*

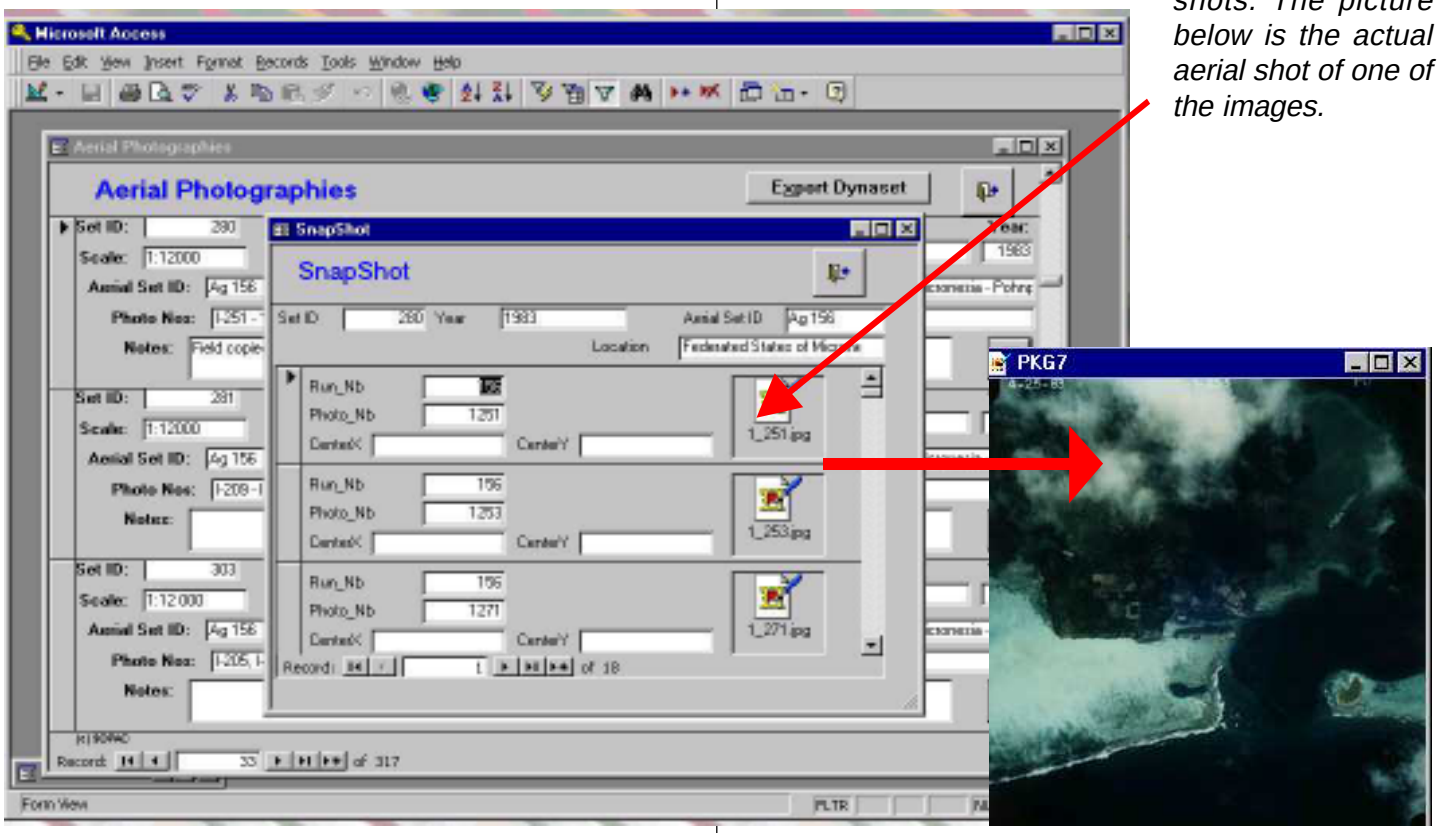


Figure 2: *Database entry on SOPAC´s web site.*

Status of GIS at Mineral Resources Department

Subashni Deo, MRD

Progress continues on the conversion of existing data from analogue to digital form and the acquisition of new digital data. The development of a broad base of digital data sources will make more GIS-based work possible using geologically related data.

Geological and Hydro-geological Maps

The 1: 50 000 scale geological map sheets (DOS Series) of Vanua Levu have been digitised and work continues on digitising the 1:50 000 scale map sheets of Viti Levu. The 1: 250 000 scale map of Viti Levu has also been digitised (Fig. 1). The hydro-geological maps of Fiji have been reconstituted from the geological maps. The hydro-geological Map of Vanua Levu (Fig.2) is complete and while the map for Viti Levu is 50% complete.

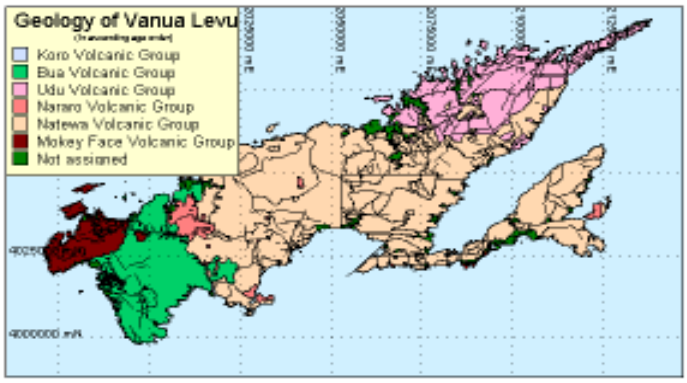


Figure 1: *Geological Map of Vanua Levu digitised from 1:50 000 map-sheets*

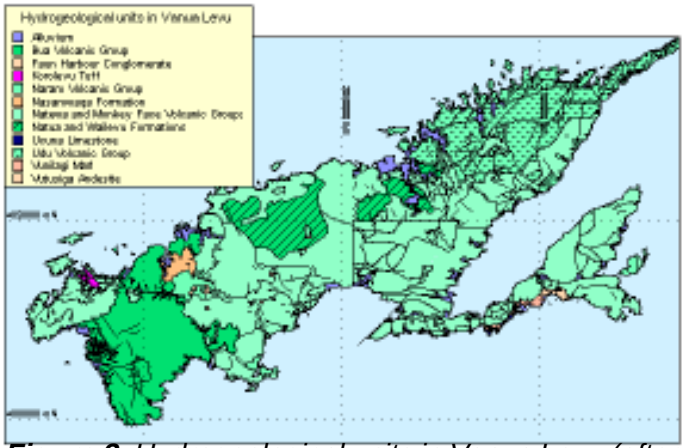


Figure 2*: Hydrogeological units in Vanua Levu (after Gale, I. N. 1987, Hydrogeological map of Vanua Levu and Taveuni, GRADU 19, Mineral resources Department, Fiji)*

Geochemical Maps

Digitising has started on regional stream sediment sample locations collected by Barringer Fiji Ltd. in the sixties and seventies. These samples were analysed for base metals. We hope to make geochemical maps of Fiji Islands with this data, delineating areas anomalous in base metals. So far sheets 1, 3, 6, and 10 have been completed (Fig. 3).

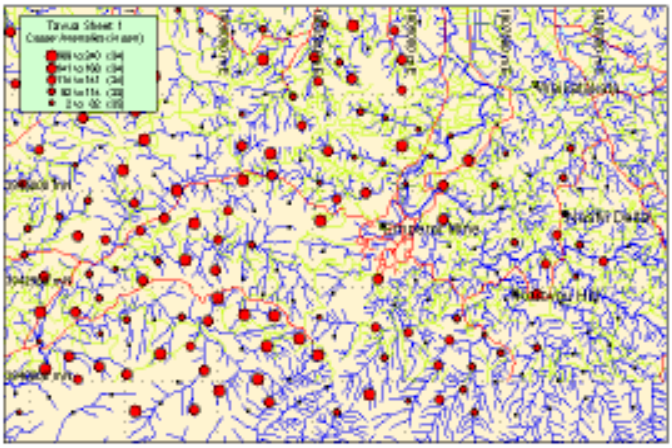


Figure 3: *Copper anomalies in the Tavua area (sheet 1)*

Aero-geophysical data

The digital elevation model, TMI image and radiometric signature of Fiji Islands have also been incorporated into our GIS database. This data is georeferenced and as such can be integrated with other datasets such as Topography from FLIS.

Other Data

MRD is also building databases of drill holes (which includes drill holes for mineral exploration and boreholes for hydro-geological survey), SPL boundaries, mineral occurrences, whole-rock geochemical analyses, samples dated by radiometric method, paleontology samples, bathymetric data, etc. To date, only some of these datasets have been georeferenced.

Seismology in Fiji; Monitoring and use of Earthquake data

Arvind Singh, MRD

Overview

The seismology section in Mineral Resources Department monitors seismic activity in Fiji by gathering earthquake data and related information. The information on earthquake occurrences is monitored by an array of seismic stations deployed around Fiji. Information from outside Fiji is gathered from international networks which monitor seismic activity in their own regional areas e.g. Australia, New Zealand, etc. Most of the international data are available free of charge through the Internet.

The seismology section is responsible for the dissemination of earthquake information in the event of a large or felt earthquake in the Fiji region. It also provides professional advice to engineers, disaster managers, insurers and a range of other interested groups.

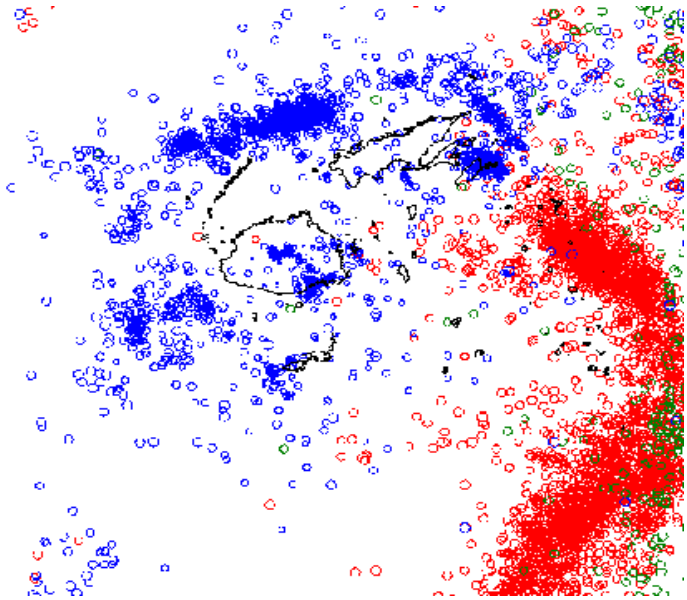


Figure 1: *Earthquakes in Fiji; blue shallow, green intermediate and red deep earthquakes.*

Earthquakes in Fiji

Compared to Australia, the Fiji region is classified as an area of high seismic activity. Earthquakes in Fiji occur at three broad regions according to depth and each of these regions is in distinct plate movement area. [see figure 01]

Shallow Earthquakes

Shallow earthquakes (depths 0-100 km) in Fiji are distributed in the west and north of the group. Very few shallow earthquakes in Fiji occur in the south or east of the group. One reason for this is related to the plate movement of both the Pacific and Indo-Australian plates. The Pacific plate moves in a northwesterly direction subducting beneath the Fiji group at the Tonga trench. The remainder of the non-subducting plate causes shallow seismic activity northeast of the Fiji group. The Indo-Australian plate also contributes to shallow earthquake activity by moving in a northeasterly direction and causing activity west of the Fiji group. The large activity north of the group is a result of both these plates pushing on the Fiji platform causing it to rotate.

Intermediate Earthquakes

There are few intermediate earthquakes (depths 100-400 km) in Fiji. These types of earthquakes are connected with activity in the molten material of the subducting plate and thus, are found on the Tonga (south-east) side of the Tonga trench, where the subducting slab is causing activity just beneath the lithosphere.

Deep Earthquakes

70% of the world's deep earthquakes occur in the Tonga subduction zone. The subducting slab causes earthquake activity at this depth because of its collision with the mantle at a depth of 700 km. The mantle is a solid rock mass and does not allow the subducting slab to go through it. The movement of the slab also causes the molten material to move upwards. [see figure 2]

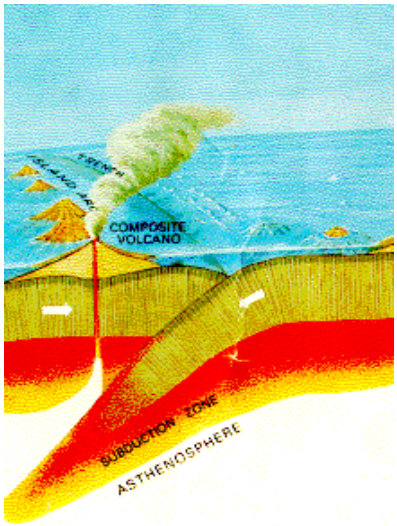


Figure 2: *Benioff Zone.*

Data Collection

The Seismology Section of the Mineral Resources Department operates a network of both analogue and digital seismograph stations in the Fiji region (see figure 3). The analogue stations are continuously telemetered and signals from these stations are recorded on paper. The digital seismographs are stand-alone recorders that require monthly field visits to download the recorded data. Attached to each of

the stations is an independent GPS module that corrects the clock on the recorder. The stations are located strategically to record earthquakes from areas that have shown a high level of seismic activity over the past 20 years. A computer also monitors signals from the continuous stations and saves data signals only if an event has occurred and is triggered by the monitoring system.

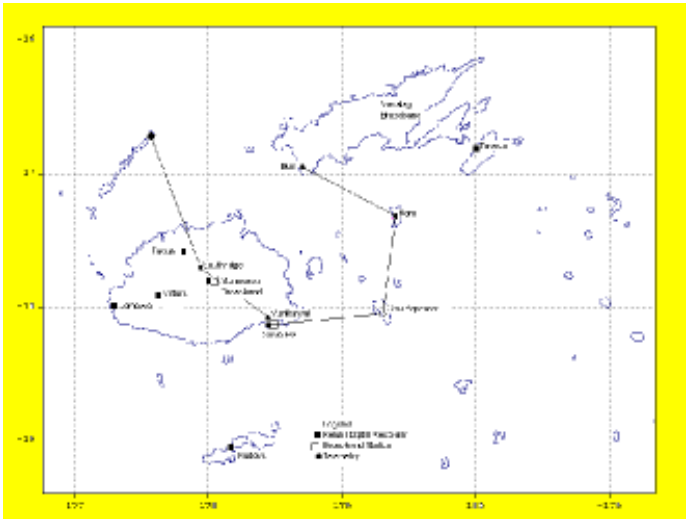


Figure 4: *Network of seismographic stations.*

Uses of Seismic data

Seismic data can be used for a variety of tasks, such as:

- Waveform data can be used to detect minerals such as petroleum
- Monitoring changes in the Gaussian field density as well as any polarising twist, preceding, during and after a seismic event
- Seismic activity can be used to locate faults. Some hidden faults in Los Angeles were identified only after an earthquake had occurred on that fault.
- Hazard risk assessment for earthquake damage. Resultant risk level information can be used by engineers to design better structures and by insurers to set premiums.
- Research for earth's interior. Most of the knowledge available today about the earth's interior has been through the usage of seismic data.

Data availability

All seismic data are available at no cost. Please direct inquiries to the Director of Mineral Development.

Topographic Mapsheets as Image Backdrop

Wolf Forstreuter
SOPAC/GOPA

The current ITTO (International Tropical Timber Organisation) financed Forest Export Marketing System project, implemented by Forestry Department and SOPAC needed to display the flow of timber from the forest to the timber product at port, where it leaves the country. Topographic maps were essential in providing image backdrops necessary for visualisation of this resource flow.

Topographic maps show features such as the river system, road network or villages, which are required to illustrate the content of thematic maps. In addition, rubbersheet correction for rectification of satellite data can use such backdrop while another use is digitising of topographic features without a digitising table.

SOPAC's A3 scanner was used for scanning larger format Lands Department maps 1:50,000 into six sections. A resolution of 100 dpi was selected to simulate a pixel size of 8 x 8m. This resolution was sufficient to display all details such as river or village names.

Adobe Photoshop was then used as a rapid method

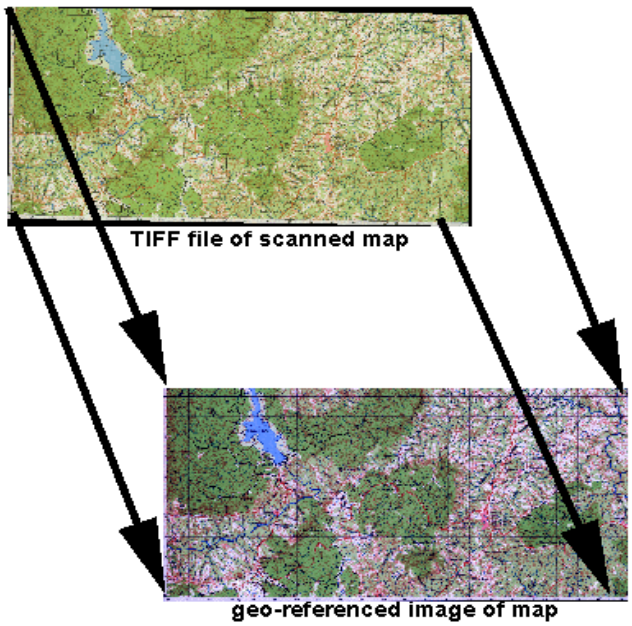


Figure 1: *After scanning the maps a linear rectification was employed for each of the six scanned sections.*

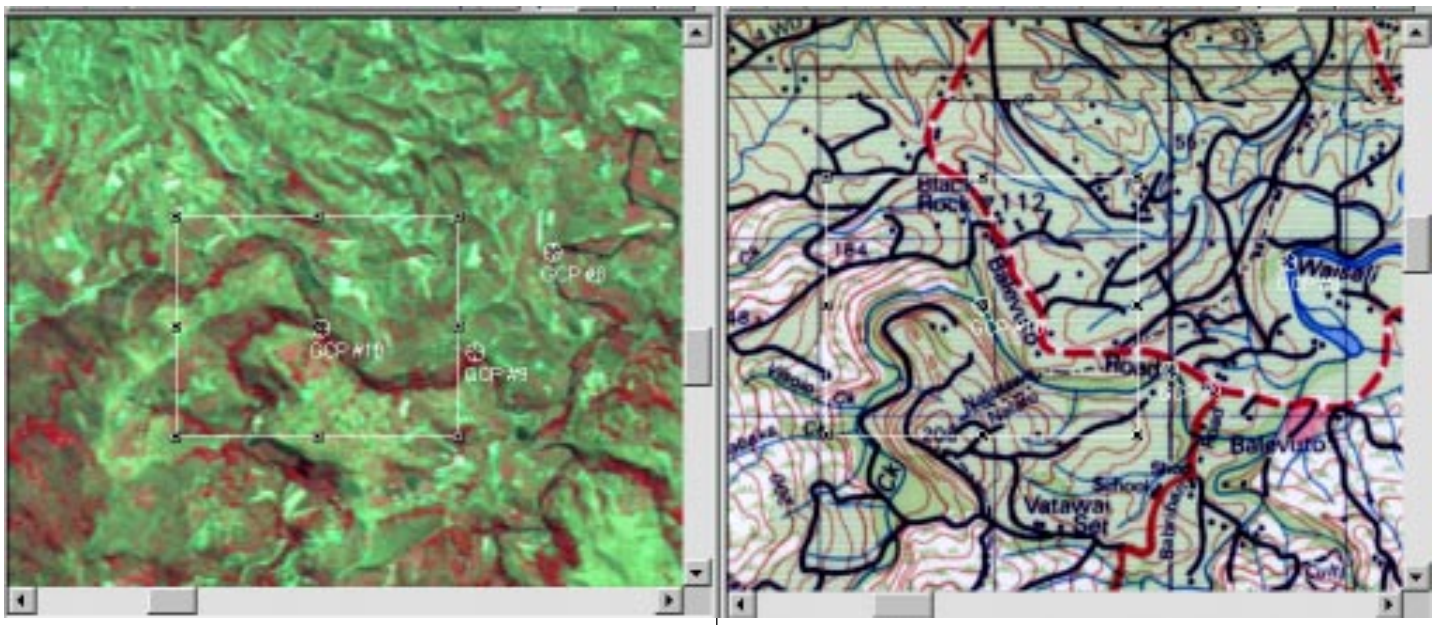


Figure 2: *Employment of topographic map as image backdrop: The picture shows image rectification using ERDAS rubbersheet module. The left window shows a SPOT image recorded August 1988 from Ba area and the right window shows the corresponding map-backdrop. GCP identification is much faster having map-backdrop.*

to rotate all sections in a northerly orientation to simplify subsequent image rectification. The sections were then stored as TIFF images.

The sections were then rectified using linear rectification to produced georeferenced images (see figure 1). The datum WGS72 was employed and not the Fiji Geodetic Datum 1986 (from WGS84). (for further information see SOPAC's web page)

The images were then stitched by a semi automatic process to recreate the original map sheet. In order to reduce file size the resolution was reduced to 10 or 15m pixel. The output format can be in GIF, TIFF or GeoTIFF. Due to its reduced file size GIF was the common format and these files are stored with the TAB file required by MapInfo.

When all maps of Viti Levu are completed a CD will be produced at SOPAC for distribution or sell on a cost-recovery basis.

The image-backdrop proved to be an important tool for illustrating GIS display as well as being essential for rubbersheet correction of satellite data. It was found that the time required to rubbersheet an satellite image to exactly fit to the topographic map was reduced by about five times compared to conventional methods. Figure x shows image-backdrop during rubbersheet rectification with ERDAS image analysis software.

Coral Reef Management in Tarawa and Abaiang, Kiribati

Robert Smith, SOPAC

Developing coral reef management plans, the benefits of GIS, remote sensing, a real data base and monitoring.

Commercial extraction of coral and sponge species for the aquarium trade in the USA, Japan and Europe is a growing industry in the Pacific. In Fiji alone this industry currently is worth an estimated 10 million dollars a year (PC Ed Lovell). Growing from what was a small cottage industry the development of resource management plans and regulatory measures for the extraction of corals and sponges is essential. In order to develop a coral reef management program, the status of the corals and sponge of interest need to be known. A project aimed at support for member countries in GIS and remote sensing development and its use in coral assessment and management in two atolls in Kiribati Tarawa and Abaiang has been implemented. The program will take advantage of the remote sensing and GIS expertise within SOPAC a combination which with ground truthing assessment of coral assemblages to determine species abundance and distribution from which a database for corals and to allow for database.

In addition to the GIS and remote sensing data SOPAC

will be undertaking a number of physical surveys in Abaiang in support of the project. This physical study is to provide a better understanding of the lagoon bathymetry, its circulation and water quality. The work will include bathymetry mapping with real time DGPS, deployment of current meters, water level recorders, conductivity temperature depth profiles and long term temperature monitoring with the deployment of 15-20 temperature loggers for 12 months. Data from the surveys will be used to develop a 2D hydrodynamic model of Abaiang from which advection dispersion and water quality models can be setup. The outputs of the models can then be incorporated into the GIS database for monitoring and management of the atoll and resources.

GIS Progress at TEPB

Edwin Liava'a

Introduction

The EU funded Pacific Regional Energy Programme (PREP), which recently came to a conclusion, has seen several major advances in the GIS capability of the Tonga Electric Power Board (TEPB). PREP, which was implemented through SOPAC in Suva, Fiji, was designed to assist regional power utility companies to improve operations. At TEPB, improvements were made in mapping of utility assets, especially power pole, power lines, and transformer connections; computer monitoring of the power network and load balancing; and integration of the assets management system with the customer billing database.

Assets Mapping and Database Establishment

Existing paper maps were digitised to establish much of the spatial database. However, there were many inaccuracies in these maps and in many areas of the country, mapping was unavailable. To remedy this situation, it was decided to use Global Positioning System (GPS) technology to accurately locate components of the power network (mostly power poles). Differential GPS, which references the mobile GPS readings to a fixed, accurately located base station, was required to obtain the required level of accuracy in the GPS work. Fortunately, under PREP, the TEPB was able to establish a GPS base station, which has become a valuable resource for both TEPB and other GPS users in Tonga.

Data on power pole, transformer and customer location and the associated attribute data is collected using the Geo-Explorer II and then geo-referenced in the MapInfo-based GIS. This information is then connected to other tabular data in the TEPB database, usually using power poles as a unique or primary identifier. The input system has the capability to connect customers to their feed power pole using a graphical "drag and drop" interface. The system also has a module that monitors the integrity of the linkages between power poles; this module can indicate which parts of the system will be affected in case of a line breakage. A MapBasic module that can connect lines between power poles is also under development.

Figure 1: *GIS display of TEPB; poles, lines and customers as top layers, a rectified aerial photograp as backdrop.*

Integration with the Billing System

The project links the spatial components of the GIS to the billing system databse in an effort to create an integrated information management system. This allows the system users to graphically examine the latest information on customer account numbers, consumption meters, pole ids, transformer locations etc. This provides a geographical overview

of our assets and customers which is often useful for revealing irregularities in power usage across the system and problems that may not be obvious from examining the lengthy printouts from the tabular (attribute) database. Ultimately the goal is improved customer service and efficiency across the system.

Such advances are helping the TEPB better serve its customers with improved system planning and more effective responses to system changes and problems. The system also allows the TEPB to be more efficient in the allocation of its resources and in managing the power network. A big benefit is the better use of the valuable power resources of the country, which reduces the need to produce electrical energy—something that is a main goal of PREP.

IT-PacNet'99 PRESS RELEASE

After a brief introduction by Victorio Uherbelau, Director, Forum Fisheries Agency, IT-PacNet'99 was opened 02 June 1999 by Martyn Robinson, General Manager, Solomon Telekom.

During this meeting, senior Information Technology staff of regional organisations meet to share and agree common regional approaches to Information Technology and Communication, ITC, issues. The meeting also act as a sub committee on IT for SPOCC.

This is the 6th annual IT-PacNet meeting since the first one in 1994. The meeting rotate between organisation and this year comes back to the first hosting organisation FFA.

In his welcome statement, FFA's Director, Mr Victorio Uherbelau reflected on the crucial role that information technology plays in the organisation action strategies to assist island countries manage fishing activities in approximate 30 million sq. km of oceans. The partnership with supporting organisation such as Solomon Telekom has been a major success factor.

Mr Martyn Robinson, General Manager of Solomon Telekom gave the keynote address and opened the meeting. He referred to the origin of telecommunication with fire, then flags and lights. Today we are talking about convergence: voice and data could now be put down in one pipe, all mixed up. In Martyn's closing summary: "The IT age has been around for a long time, it has just got faster and carries more data". What is in store up for the next 100 years is definitively very difficult to envision.

This year's focus is:
Exchange information and experiences on effective and standardised Information Technology and Data Communication Applications Systems that support the Business needs of Pacific Islands countries.

Pacific Islands Chapter of the Internet Society formed

A Pacific Chapter of the Internet Society (ISOCPAC) was formed in Honiara during the ITPacNet99 meeting.

ISOCPAC aims to bring together Internet users of the Pacific to systematically create a conducive environment for the promotion and growth of Internet technology and its application in the region. Internet technology is creating opportunities in Pacific island countries which overcome difficulties created by distance, isolation, dispersion and national budget constraints in the development needs of the Pacific countries.

ISOCPAC covers the following countries: American Samoa, Cook Islands, Commonwealth of the Northern Marianas, Federated States of Micronesia, French Polynesia, Fiji, Guam, Kiribati, Nauru, Niue, New Caledonia, Palau, Papua New Guinea, Pitcairn, Marshall Islands, Samoa, Tokelau, Tonga, Tuvalu, Vanuatu and Wallis and Futuna.

An interim executive council was endorsed and is made up of Mr. Alasdair Blake (Chair), Mr. Franck Martin (Vice Chair), Ms Donita Simmons (Secretary), Mr. Norman Kapun (Treasurer) and Mr. Herve Dropsy (Coordinator of Standing Committee).

ISOCPAC members will be connected through an email mailing list of Pacific Islands Users Group (PIGnet) on email address pignet@spc.org.nc

Membership in ISOCPAC is open to all residents of the Pacific Region. Interested persons should contact Mr. Al Blake on email address: alb@spc.org.nc or Mr. Franck Martin on email address: franck@sopac.org.fj. There is a membership fee of US$35.

ITPacNet 99 is the sixth annual regional meeting of senior information technology staff of regional

organisations, members of the South Pacific Organisations Coordination Committee (SPOCC). SPOCC members are Forum Secretariat, Secretariat for the Pacific Community, South Pacific Applied Geoscience Commission, Forum Fisheries Agency, South Pacific Regional Environment Programme, University of the South Pacific, Tourism Council for the South Pacific and Pacific Islands Development Programme.

All the participants of the ITPacNet99 are the founding members of the Pacific Islands Chapter of the Internet Society.

The Internet Society located in New York is the organ in charge of promoting the adoption of Internet throughout the world. Composed of individuals, it also hosts the IETF, Internet Engineering Task Force which is responsible for drawing up Internet protocols and standards. Due to the geographic particularity of the Pacific, it was considered more practical to create a Pacific chapter, the first such chapter with a regional focus.

The current members feel that the Pacific Chapter will provide valuable representation to the ISOC meeting, INET

GIS Metadata Project Presentation

Frederic Serafin, SOPAC

SOPAC maintains a regional data centre and provides information services for various people. With the increasing amount of data, the need appears of a powerful system, which improves access to information. SOPAC decided to develop a digital Metadata system under the widely used ANZLIC metadata standard (Australia New Zealand Land Information Council).

What is Metadata ?

Metadata is data about data. It is a description of the characteristics of data that as been collected for a specific purpose. If access to land information is to be maximised, adequate descriptions of the characteristics of all geographically referenced data must be available and accessible. In other words when you collect data for public purposes you need additional information which documents and completes the data.

GIS users also have to document the data with information which will help the users of data to exploit it. For example to find the data you need among millions of data set, GIS users have to describe as much as possible the history of the data with a explicit title, a summary, a precise location, a system of search word and a system of important date. As well to allow customers from other organisation to access our data or to compare results, an evolution report and a list of competent contact have to be provided.

Why use the ANZLIC Metadata standard?

Between 1994 and 1997 ANZLIC has developed and implemented a national land and geographic data directory (ANZLIC CORE METADATA) which has been now successfully tested. ANZLIC and SOPAC have the same goals and as neighbours and collaborators we have to be able to exchange our information and use the same standards.
SOPAC has added several items to the ANZLIC METADATA standard in order to complete the information needed. The projection information, the scale of the data and the logical location of the data record were added. With this lightly modified Metadata standard SOPAC is developing such database under MS SQL Server 7.

MapInfo and SQL server 7

In a first time SOPAC is developing a MapInfo interface that provides easy access to metadata through the SQL Metadata database. Thus a MapInfo user will be able through this interface to store GIS metadata of his working files. The metadata will be placed in the SQL database and also being written in the .tab MapInfo file. It will allow the MapInfo user to search and find the MapInfo file he needs. The user will enter some criteria such as the file name, a part of the title, the custodian, some keywords, geographic names or polygons limits. This will simplify the research of the right geographical information instead of looking for a filename through endless directory structures.

World Wide Web

However, the important point of this project is to provide the MapInfo data and the other data of SOPAC through the WWW. For this a portable interface will be developed using a specialised HTML Document Type Definition (DTD) compatible with the ANZLIC standard. The SQL database will generate on the web a dynamic catalogue of GIS data. It has been proven that GIS catalogues are much needed in the Pacific. This system, the SQL database and the MapInfo interface, will also be implemented to any organisation willing to

participate in this project. It will provide a mean to exchange information between organisation. The GIS catalogue will be automatically synchronised between each organisation SQL servers via e-mail. Already several regional organisations have shown their interest in such project.

Towards data exchange

SOPAC with this project will be able to provide an effective system to promote Pacific geographic data all over the world at low cost. It can help for the development of any project or foreign investment in Pacific Island member countries. The release of all the MapInfo and SQL tools will be soon announced over SOPAC web site (www.sopac.org.fj). If you are interested in participating in this project, please contact us.

Satellite Image Data News

Landsat

Landsat 5, which is still in orbit and recording image data, cannot download data in the South Pacific, because this large area is out of any ground-receiving antenna's footprint. Landsat 7 has tape facilities onboard and can store data from the Pacific and download to antennas in Kiruna (managed by SSC, see last newsletter 9901). The South Pacific is waiting for Landsat 7 data. The satellite was successfully launched in April this year, see last newsletter.

Here the story so far: 3 June, Landsat 7 completed a tandem phase where it under flew Landsat 5 so that the better calibration of the Landsat 7 system could be applied to Landsat 5. After that was completed, Landsat 7 successfully went to the correct orbit and began image recording. The first image data sets will be provided for developers. The first commercial sales are expected in August, the data collection for the archive has already started.

Landsat 7 has the best spectral resolution of the existing commercial remote sensing satellites. The blue spectrum, important for reef mapping, is covered.

SPOT

For the time being, the SPOT satellites in orbit are the only spaceborne platforms of which image data, usable for mapping at 1:50,000 scale, can be purchased without any complications. Since launch of SPOT 4 last year, several scenes have been recorded from Viti Levu and Vanua Levu in Fiji. SOPAC purchased one scene covering Ba area. This scene was recorded in August 1998 and will be analysed to show the impacts of drought.

SPOT 4 has a short wave infrared channel, this part of the spectrum was not covered by the previous SPOT satellites.

IRS-1C

IRS-1C or the twin satellite IRS-1D is theoretically able to record and deliver images from the South Pacific due to their onboard tapes. 1998, SOPAC asked for special acquisition to record panchromatic data (5m resolution) from Niue. Due to management changes data from the South Pacific have to be purchased from NRSA in India and not through Space Imagine EOSAT in USA like before. The procedure was too complicated to get image data in time. SOPAC is still waiting for the money refund.

High Resolution Satellites

Three high resolution satellites were supposed to be launched this year. IKONOS 1, its twin IKONOS 2 and QuickBird. All three satellite could provide image data of about 1m spatial resolution in panchromatic and 3 to 4m in multispectral mode. IKONOS 1 was launched, but never reached to orbit and nothing was heard from the other two so far.

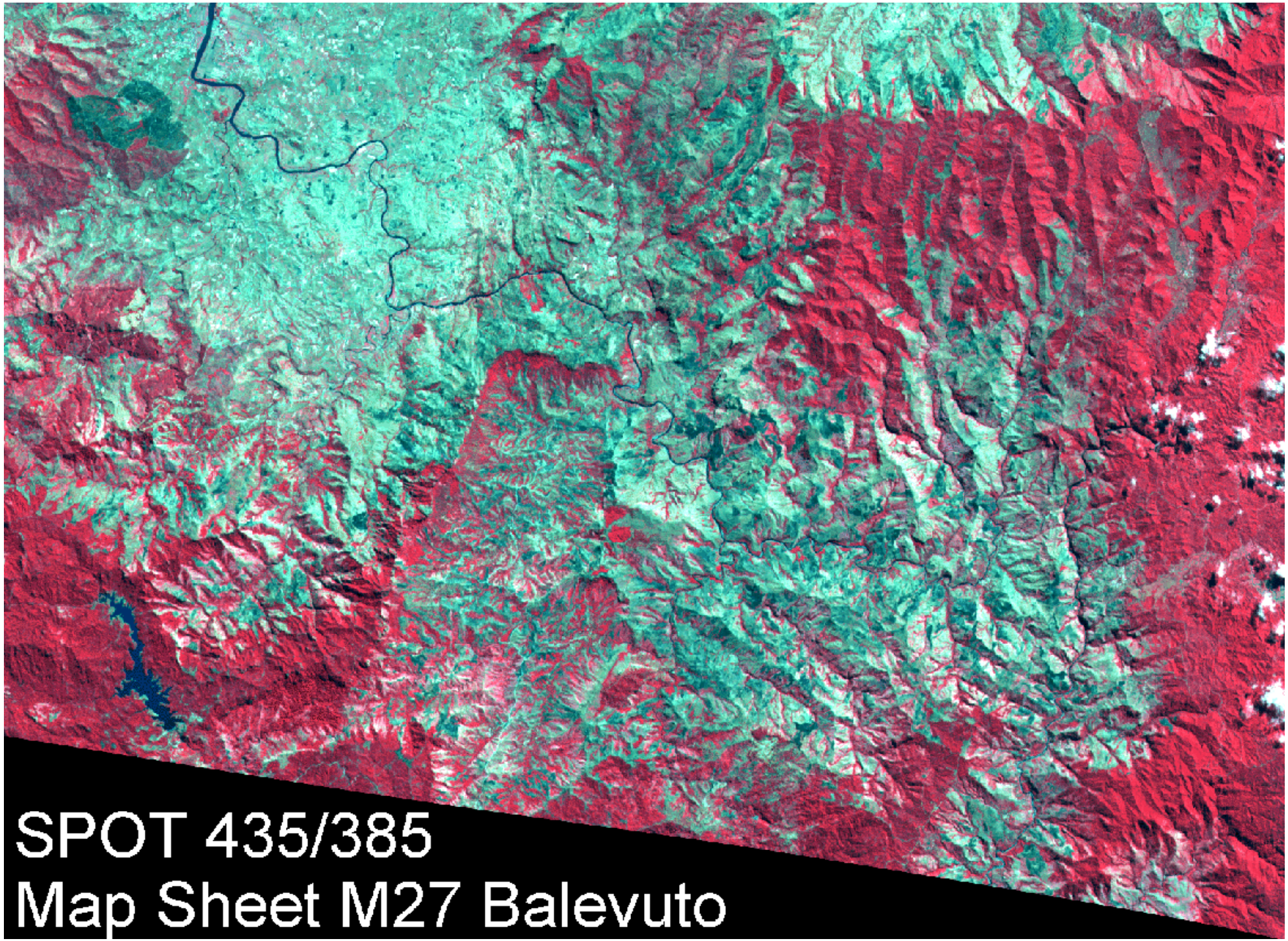
MIR

The Russian space station MIR is equipped with several cameras and theoretically images could be purchased from the South Pacific. There was even a modern push broom scanner onboard. However, the marketing of the products was poor and no images were bought for the Pacific. Although the crew just fixed an antenna of 7m diameter outside the station last week, Russia will sink MIR in the Pacific, next year. Russia is looking for private investment to run the station. If there is nobody willing to take over MIR's fate will be under water unable to provide spaceborne data for Pacific Island Countries.

Articles please send to:

Wolf Forstreuter (SOPAC)
Fax: +679-370 040
Email: wolf@sopac.org.fj

James Britton (USP)
Fax:: +679-301 487
Email: britton_j@usp.ac.fj


SPOT 435/385
Map Sheet M27 Balevuto