Pacific Islands
GIS&RS NEWS

The Newsletter of the GIS & Remote Sensing Users in the Pacific
Issue 1/2009
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Five Years of EU Support for GIS and Remote Sensing: Applications are Growing in Pacific Island Countries

The Pacific Islands GIS and RS User Conference took place in Suva at the University of the South Pacific from 2 to 5 December 2008. The conference was organised by a multi-stakeholder conference committee with members from SOPAC, USP, FLIS, FEA and NLTB. The Conference was opened by three key note speakers 1) Head of the EU Delegation in Suva, Mr. Wiepke Van der Goot, SOPAC's Director, Cristelle Pratt, and the Permanent Secretary for the Ministry of Lands and Mineral Resources, Maria Matavewa. 164 people registered on the conference website and about 150 attended the conference coming from 13 different countries. During four days nearly 50 PowerPoint presentations and verbal speeches were given. On day four of the Conference discussion among as many as 80 Pacific Islanders talked about 11 different subjects of GIS and RS applications, where methods and techniques have been developed or adapted for Pacific Island Countries. Every evening a social program provided the avenue for networking among Pacific Island GIS officers and software, hardware and image data providers, suppliers and other users. An exhibition room had information about hardware, software, image data and applications on display. This room was also used to meet during the coffee breaks.

In conclusion, the presentations and exhibitions showed that the GIS and Remote Sensing tools are applied by the Pacific Island Countries. The Conference was dominated by users who showed their applications in the Pacific, which is strongly linked to the objectives of the main donor in this area, the European Union. Also the discussion on day four of the Conference demonstrated the commitment of Pacific GIS users.

Wolf

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ALOS (Advanced Land Observing Satellite) the alternative for 1:25,000 scale mapping. This Japanese satellite provides multi-spectral image data with 10 metre spatial resolution for the bands blue, green, red and near-infrared recorded from a sensor called AVNIR-2 (Advanced Visible and Near Infrared Radiometer type 2). The satellite has other sensors onboard where one of them PRISM (Panchromatic Remote-sensing Instrument for Stereo Mapping) is capable of looking forward and backward to create stereo data usable for DTM creation with nearly 5 metre accuracy, which allows contour lines of 10 m. The spatial resolution of PRISM is 2.5 metre, where this data can be also utilised to pan-sharpen the multi-spectral image data. Such data sets then allow thematic mapping at 1:10,000 scale.

SOPAC is currently in negotiations to distribute ALOS data for users in Pacific island Countries.

Western Viti Levu (Fiji) recorded from ALOS

Marine Conservation Prioritization

Paul Anderson, SPREP

Introduction

Conservation planners working at the national and regional scale need to answer the question "how can the locations most in need of conservation/ protection be best identified?" In the marine context, this question is particularly important given the deterioration in the marine environment that has occurred due to changes in harvest methods, population pressure and environmental pressures as well as our early stage in the development of marine managed areas (MMA) and marine protected areas (MPA). An efficient system of identifying and prioritizing protected sites is required to answer this question. By mapping locations of threatened species and populations that are highly aggregated in time or space, the Key Biodiversity Area (KBA) process which SPREP is employing allows marine sites of global biodiversity significance to be

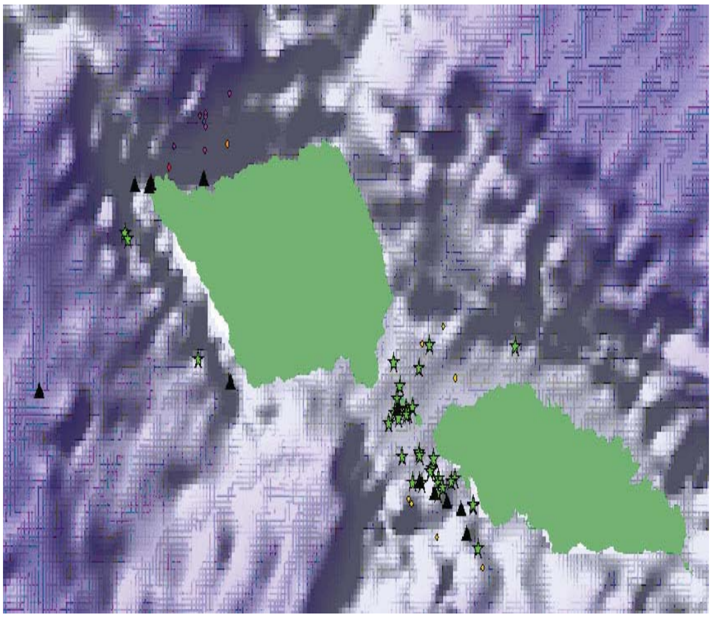

Figure 01: *IUCN red listed species, Samoa*

systematically identified. KBAs are sites of global conservation significance that are actually or can potentially be managed for conservation.

Background

SPREP is using physical and biological marine observations to assist members plan and create MMAs and expand MMA/MPA networks. One of the driving forces behind this analysis are the numerous conservation pledges that have been made by Pacific Island Countries and Territories including - The CBD 2012 goals, National biodiversity strategies and action plans, Fiji's 30% coastal marine protected area commitment, the Micronesian challenge and the two Samoa's initiative which all call for expanded coastal marine protection. Another driving factor for this work is the current status of near shore biodiversity. In the past, intensive near shore fisheries often were supplied by populations reproducing in "natural" refuges—places that were too deep, too remote, too dangerous, or too rough to fish. However, as the reach of fishing expands, and population pressures increase and coral health declines, much of the near shore fisheries are

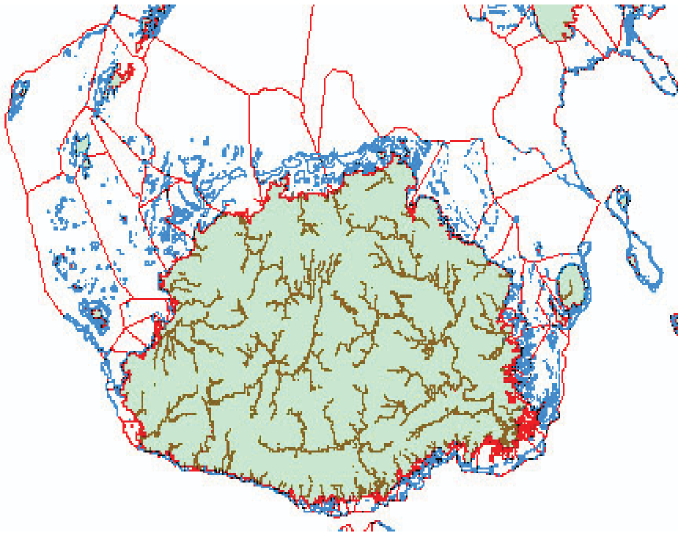

Figure 02: *Fiji Qoliqoli areas, the question is where to locate marine managed areas.*

having to rely on fewer and fewer sources of recruits. Without refuges, MMAs, MPAs and proactive management the future for Pacific reef fish is bleak. This is why MMAs, MPAs and expanded networks are so important

Process:

To address the issue of conservation prioritization SPREP is collating data from many sources, then cataloging, mapping analyzing and publishing it. A number of key datasets need to be compiled in (GIS). These include range maps and locality records of target species (i.e., species that trigger the KBA criteria), and contextual data layers that are available, such as bathymetry, habitat maps, political/traditional boundaries, and management units (including existing MMAs/MPAs).

The 6 main steps to identifying KBAs and marine

Figure 03:*Vulnerable IUCN red listed species- Bumphead Parrot Fish*

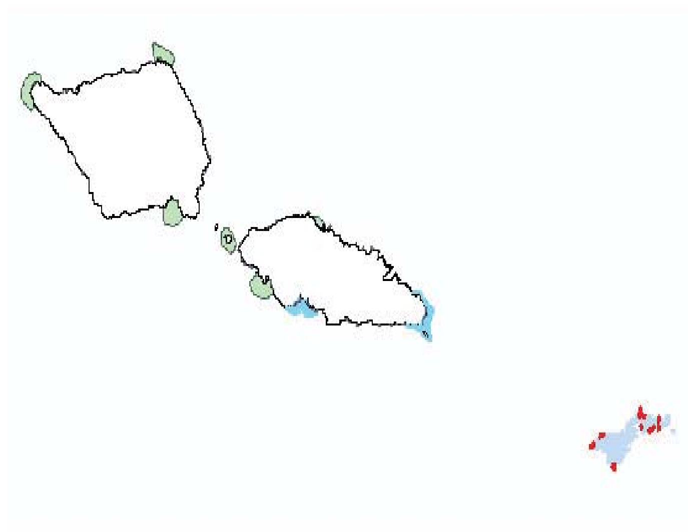

Figure 04: *Potential MMA network including Samoa and American Samoa*

managed area networks are listed below:

- Compile a list of species that can potentially trigger KBAs, and map localities at which they occur.
- Apply thresholds to populations of each trigger species to identify KBA sites.
- Delineate KBA boundaries by overlaying locations of threatened species and populations of other species that can trigger KBAs with available maps describing management units (particularly those showing boundaries of existing and proposed MPAs), habitats, bathymetry and geomorphology.
- As resources allow, identify and undertake appropriate actions to safeguard KBAs and populations of trigger species within. This activity will generally begin with the development of a prioritization framework for KBAs within the region in question, and include the establishment of a monitoring program.
- Document data used and all steps undertaken during the KBA identification and delineation processes.

Results

There are several outputs of the KBA analysis aside from the identification of key biodiversity areas. The supporting literature and GIS data is compiled into databases to allow for future iterations of this work and other marine applications.

Source database - Because there are so many types of data sources for the species location spatial information and there is no one clearinghouse for this data, it is critical to document the sources of supporting data in the GIS. SPREP is addressing this by uploading the sources to a literature database where they are assigned a unique identifier which can be used as an attribute in a vector layer and in the metadata for the layer, thereby linking the source to the spatial data. All published literature, historical surveys and expert commentary is input into this database which will be available to the public early next year.

GIS database – The GIS layers created as the result of the KBA analysis as well as the contextual data layers used in the analysis are compiled into a national marine data set.

MMA Networks – By identifying the types of habitat and species of concern that are currently represented in managed areas the results from the KBA analysis can help link existing sites into a strategic system of resilient, linked sites that conserve and enhance biodiversity by including underrepresented sites, species and replication of key site types.

Challenges

Species Data: Due to the long history of marine research in the region being conducted by different government agencies, NGOs, overseas scientists and regional organizations there are many sources of data on species of concern which serve as the triggers for KBA site prioritization. Locating all sources for a particular area or species has proved to be a major undertaking. In response to this challenge preliminary analysis and results are shared widely to elicit comments, data and recommendations from the wider conservation community.

Spatial data – Many of the contextual data layers used for terrestrial KBA analysis are lacking in the marine environment. For example, bathymetry for near shore areas is lacking for many islands and habitat and habitat proxies in marine environments have only been developed for specific locations. Part of the results of the KBA analysis is a gap analysis of what data, both spatial and taxonomic, is lacking, thereby highlighting the areas for future work.

Connectivity Issues.

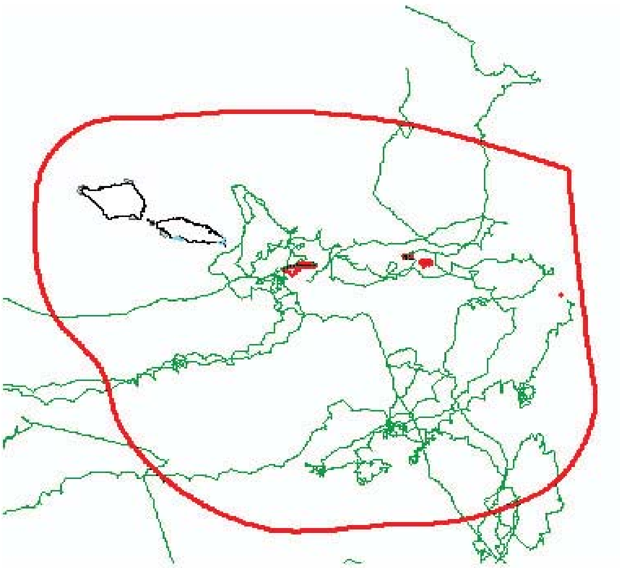

Figure 05: *Drifter data from the Samoan Archipelago used to view connectivity. The red polygon is the 30 day travel distance for the drifters.*

Summary and Recommendations

Applicability – All Pacific island countries can utilize and adapt the KBA methodology to help prioritize their conservation goals and achieve their respective protected area commitments.
Local commitment – The since local ownership is critical to the success of protected
areas, prioritization of KBAs including identification, delineation and implementation, is best achieved through activities undertaken at local and national levels.

For more information visit www.kba.conservation.org to download the marine KBA manual and paula@sprep.org with any questions.

The Asia Pacific Natural Hazards Information Network (APNHIN): Providing Geospatial Data and Fostering Data Sharing Partnerships

Todd Bosse, Senior Geospatial Information Analyst
Pacific Disaster Center

Pacific Disaster Center hosts the Asia Pacific Natural Hazards Information Network (APNHIN), a suite of applications and information services providing disaster managers, planners, governments, and nongovernmental organizations with instant access to a wide spectrum of high-quality geospatial data resources.

Built upon the underlying specifications and technologies of ESRI's Geography Network (http://www.geographynetwork.com), APNHIN is a metadata search tool which has been customized to provide users with a web-based form with which to search for, evaluate, and download data. APNHIN requires only a standard browser to connect. Users can search for data using a range of options such as:

- Theme Keyword (i.e. river, flooding, volcano, etc.);
- Place Keyword (i.e Hawaii);
- FGDC Content Keywords (Admin & Political Bounds, Oceans & Estuaries, etc).

In addition to these options, users of APNHIN can search for data on recent international disasters by entering the GLIDE number (http://www.glidenumber.net) or by entering the words "International Charter" to locate a disaster for which the International Charter "Space and Major Disasters" (http://www.disasterscharter.org/) has been activated.

The results of a search will present the user with metadata in fully compliant ISO 19115 format (and FGDC where applicable). The metadata will inform the user of important information such as source, date, use/access constraints, and point of contact to obtain the dataset. The data in APNHIN comes from either PDC's data environment or one of the APNHIN partner organizations.

PDC Enterprise Geospatial Database (EGDb)

APNHIN draws upon PDC's Enterprise Geospatial APNHIN draws upon PDC's Enterprise Geospatial Database (EGDb), a comprehensive geospatial data management and storage environment. The EGDb supports a wealth of remotely sensed imagery and GIS layers acquired from a variety of sources at different spatial resolutions, which have been processed to consistent specifications, integrated, and subjected to quality control steps. EGDb includes data such as:

- Active and Historical Hazard Events (Tropical storm, volcano, tsunami, earthquake, etc.);
- Critical Infrastructure ;
- Emergency and Public Services;
- Environmental Characteristics;
- Demographic and Socio-Economic Data; and
- Baseline Topographic Data.

APNHIN provides access to PDC's unique dynamic data on frequently changing weather and natural phenomenon such as those currently deployed in PDC's Asia Pacific Natural Hazards and Vulnerabilities Atlas (http://atlas.pdc.org). APNHIN users are provided access to frequently updated, value-added information on phenomena including tropical storms, earthquakes, volcanoes, wildfires, rainfall, and flooding.

Become a Partner of the APNHIN Community
By building collaborations with partner organizations, APNHIN has grown over time to form a community of information-sharers, and it is growing still. Joining APNHIN is formalized by a Memorandum of Understanding (MOU) with Pacific Disaster Center.

Identifying, collecting, processing, and maintaining geospatial data layers can be extremely time consuming—accounting for nearly 80% of the cost of deploying a GIS-based decision support or resource management application. By providing instant access to a wide spectrum of high-quality data resources, APNHIN becomes an indispensable asset to disaster management decision-makers.

Organizations/Agencies who have information resources that can be shared are encouraged to become APNHIN Partners. When information is shared in this fashion the high cost of data collection, processing, and maintenance is spread among many, reducing the cost to each. Additionally, the data are more likely to be current since they are retrieved each time from the originator rather than a duplicated archive.

The creation of metadata records is crucial for APNHIN participation. All information, whether map services or data files, must have compliant metadata meeting some minimum standard—preferably either International Standards Organization (ISO) 19115 or Federal Geographic Data Committee (FGDC), but at least enough information to allow users to search and locate desired datasets.

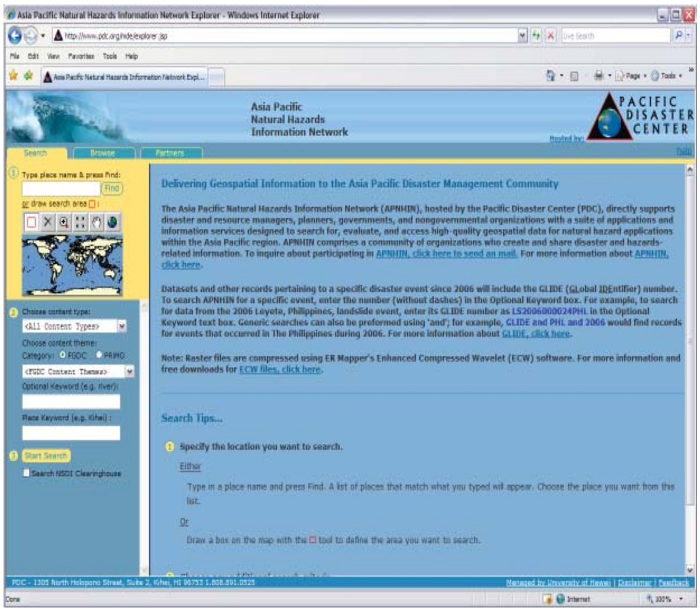

Figure 01: *This is the simple form that starts an APNHIN data search.*

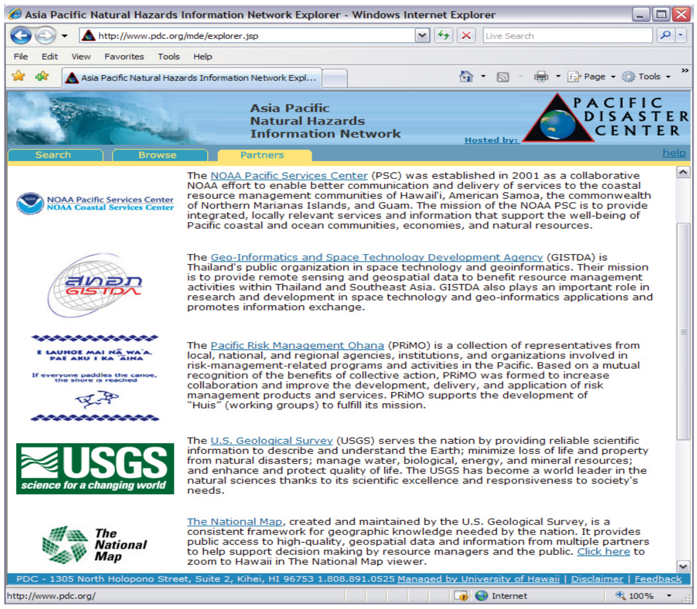

Figure 02: *A tab on the APNHIN website provide information on data-partners*

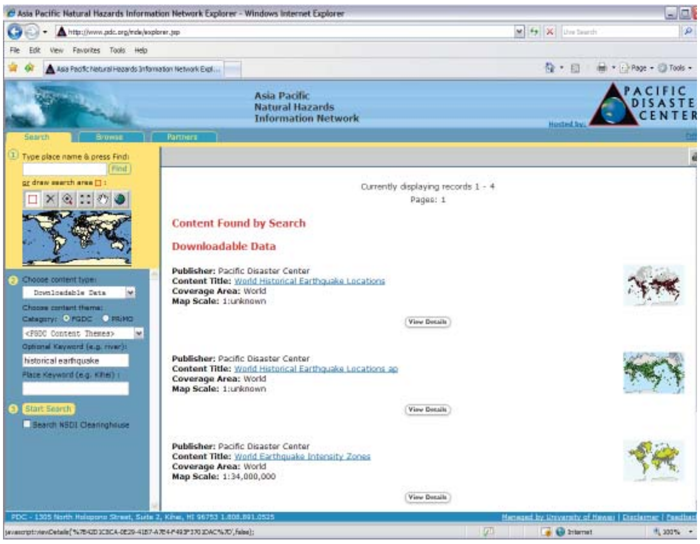

Figure 03:*This screen shows the results from an APNHIN search for data on historical earthquakes.*

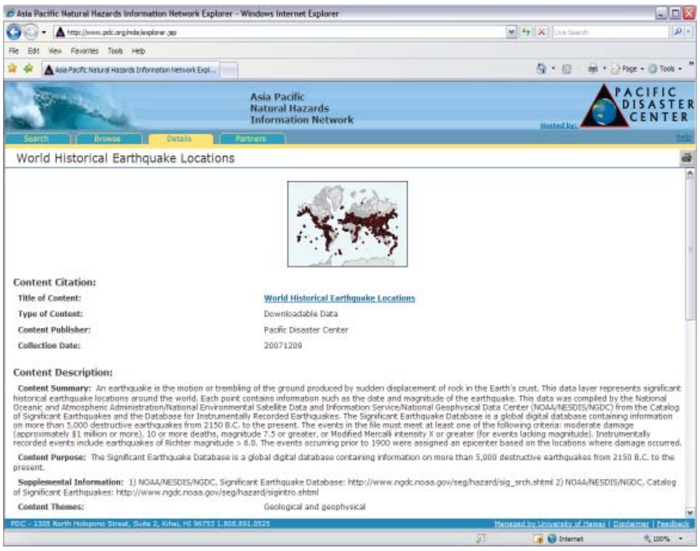

Figure 04:*This page shows the details of the World Historical Earthquakes dataset in APNHIN.*

Recognizing that effective metadata authoring can be a daunting task to those not currently working with metadata standards and tools, PDC has prepared templates for many of the commonly used data sets. As part of our "APNHIN Startup Kit," PDC provides these templates and other training documents to new members.

To access APNHIN go to: http://apnhin.pdc.org.

To inquire about becoming an APNHIN Partner send an email to: apnhin@pdc.org.

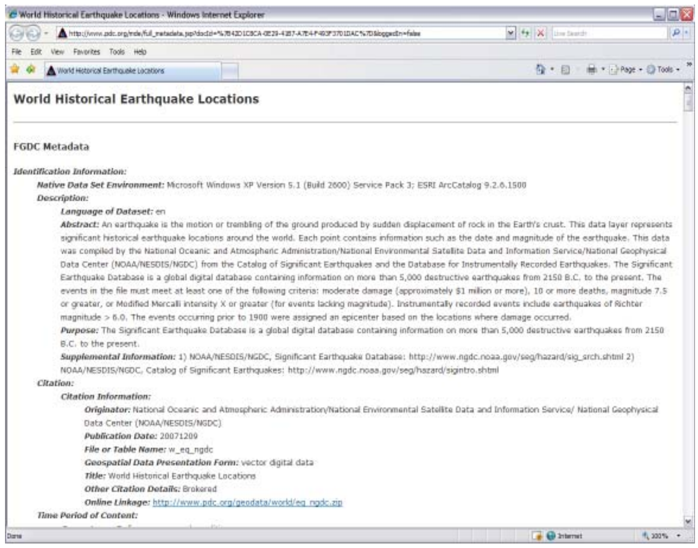

Figure 05:*This page shows the full metadata for the World Historical Earthquakes dataset in APNHIN.*

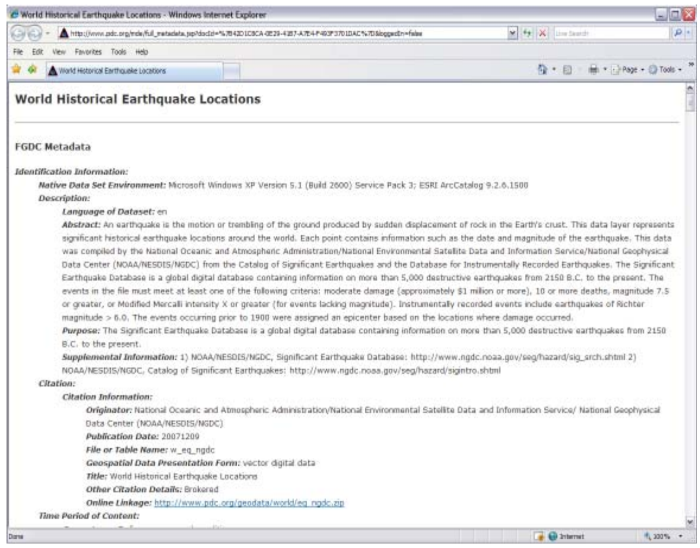

Figure 06*:This screen shows the results from a search for data holdings of an APNHIN Partner. In this case the Partner is the NOAA Coastal Services Center.*

Current data-partners in APNHIN include:

- NOAA Pacific Services Center (PSC) ;
- Geo-Informatics and Space Technology Development Agency (GISTDA);
- Pacific Risk Management Ohana (PRiMO);
- U.S. Geological Survey (USGS) ;

- The National Map;
- Hawaii Clearinghouse of USGS; and
- Pacific Biodiversity Information Forum
- Partnerships in progress:
- Pacific Islands Applied Geoscience Commission (SOPAC); and
- U.N. Office for the Coordination of Humanitarian Affairs (OCHA).

Introduction to Quantum GIS

Keleni Raqisia
SOPAC

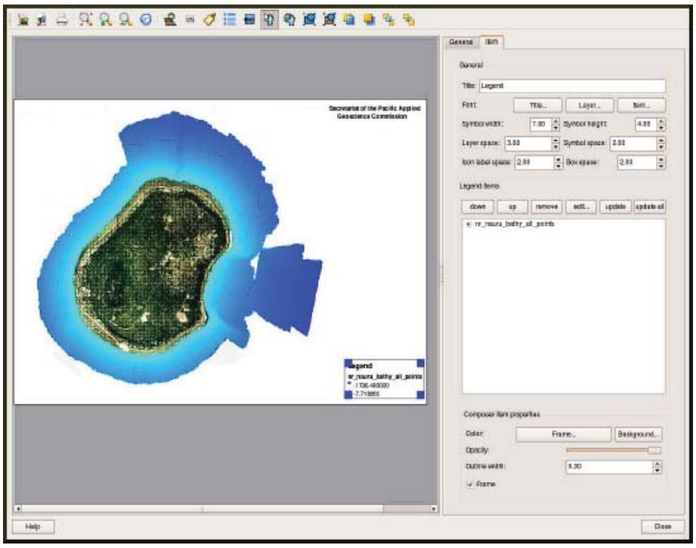

Figure 01*:QGIS Map Composer Interface*

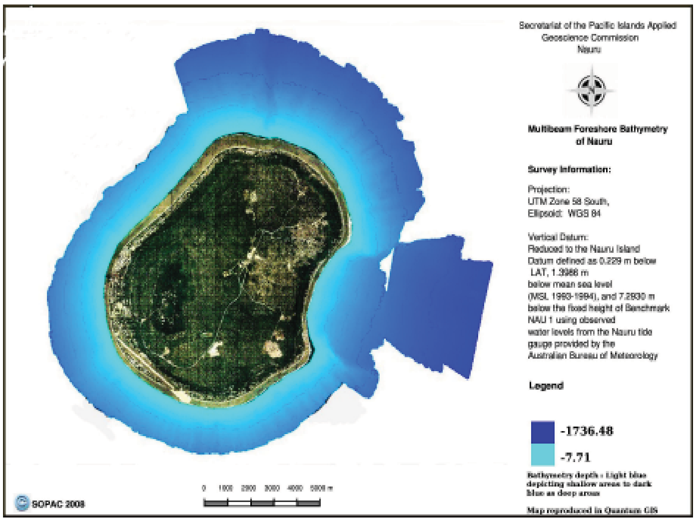

Figure 02:*QGIS Map Layout*

The main limitation to the use of GIS software in the Pacific ,is usually the issue of the hefty cost associated with the software and with due consideration to which GIS software individuals may prefer to use or what users generally are accustomed to. An emerging option available today is the use of Open-Source GIS software.

Quantum GIS , is one of those Open-Source desktop GIS application that has been used within SOPAC and has proven to produce similar results to what proprietary GIS software can do.
Being Open-Source the software is free of cost. It runs on Linux, Unix, Mac OSX, Windows XP and possibly others and is user-friendly. It supports vector data file formats including Esri shapefiles, Map Info Mif / Tab file formats, oracle spatial, GML and Post GIS file formats.

QGIS also supports raster data sources to include tools for importing Grass raster file formats, Web Map services formats (WMS) and provides support for file based GDAL). It allows for viewing of layers and with its current QGIS version 1.0.0 Preview tool, includes improved editing functionality for layers and attributes, such as copy/cut/ paste features, vertex editing, snapping and panning during digitising of layers and also allows for GIS analysis through PlugIns including the improved fwtool PlugIn which allows for geo- processing functionality such as clipping/ dissolve, buffering, union and intersect. Sampling tools for selecting by location/ select by attributes and integration with other open GIS packages such as Grass. QGIS also has thousands of defined projections available with functionality allowing search by EPSG Code or by projection name, dialogue to enable "on the fly projections" and customising projections.

The current QGIS version 1.0.0 Preview 2 also has improved Map Composing tools to enable easy navigation and organisation of map elements.

Quantum GIS is currently being used within SOPAC as a support software for creating maps and eventually producing thumbnails for the SOPAC GEONETWORK website a repository that houses and allows the sharing of geographically referenced thematic information between different organizations.

Currently QGIS has being utilised to produce bathymetry maps, showing differences in depth around survey area . XYZ files are imported into Quantum GIS as text delimited files and using the layer properties to give a continuous colour and classification of the depth value showing the maximum and the minimum value. Quantum GIS has also being utilised as an effective viewing tool allowing visualisation of survey control points , survey ship tracks and viewing of various types of ocean survey, Ariel and satellite imagery .

Quantum GIS has a long history of its development. Its capability to perform GIS functionalities has improved tremendously as well, to now include performing GIS analysis . Though Quantum GIS may not be seen as having the ability to convincingly replace ArcGIS or MapInfo, QGIS with its continuous daily development to its functionalities, QGIS can be viewed as another option for GIS users in the Pacific where financial resources is limited

Applications of GIS and GPS to Reduce Vehicle Fuel Use

Dr. Turlough Guerin, Telstra Corporation Limited,

Melbourne, Australia

Fuel used in road transport is a major contributor to greenhouse gas emissions and global warming. Consider this. The transport sector in Austalia contributes 14% to national greenhouse gas emissions. The information Communications and Telecommunications industry (ICT) contributes to just 0.3%. ICT, GIS & GPS can cut the amount of fuel we burn for road transport.

As GIS/GPS professionals I don't need to tell you about the consequences of global warming on habitats and ecosystems. Making sense of large masses of geographic and time course data is a critical role that you as professionals, and researchers, contribute to understanding the impacts of climate change. Just a 2 degree increase in global average temperature will be sufficient to see the onset of irreversible impacts of dangerous climate change. Unfortunately, with our current rates of greenhouse gas emissions to the atmosphere, we are on track to see this rise of 2 degrees unless we make deep cuts.

Smart ICT, GPS and GIS based systems, that can improve the efficiency of how we use fossil fuels, has to be a priority. Road transport systems are woefully, inefficient. The Australian Bureau of Statistics reported a few years ago that commercial vehicle utilisation was about 70%. That is one I every 3 trucks on Australian roads are empty. In addition to inefficiencies, transport costs are trending upwards. Road congestion in Australia is estimated to cost the economy 6 billion dollars (Australian) a year.

And the current recession means that transport costs are coming under closer scrutiny. Fuel prices will track upwards again even though the crude oil is now down to $50/barrel. In reducing fuel usage, consider what we are doing in Telstra right now using GIS/GPS: both for our enterprise and government customers and ourselves.

We are enabling the efficient deployment of field work forces, linking field staff to jobs in the shortest possible time with least travel distance using

Figure 01:*Real-time vehicle tracking and activity monitoring to help reduce operational costs and improve productivity, safety and customer satisfaction*

Trimble Geo Manager . Let me explain. Trimble GeoManager is a product offered to our enterprise and government customers to improve the efficiency of their field work forces and fleets. This product relies on field staff being connected via wireless broadband. It finds the shortest distance between jobs so work can be scheduled in the most time effective and spatially efficient way. It leverages GPS technology with the additional feature that it sends a regular positioning signal to a satellite.

It allows work schedulers to match the closest field staff, with the needed skills, to the next nearest job. Trimble is now reducing travel kilometres between field jobs by 6%. When running a large field work force and vehicle fleet, like ours, this equates to millions of litres of fuel saved each year. Telstra has a vehicle fleet of around 14,000 vehicles. But the greatest value in implementing Trimble has been the recovery of lost time from the field workforce. Telstra has seen an increase of 13 percent productivity in the field work force since installing Trimble in the past year alone. Through our directories and search business, Sensis, which is a wholly owned subsidiary of Telstra, we are offering our customers online maps. The concept is simple. In conjunction with our directories, we are helping our consumer customers and small businesses, to find what they want quicker, with the least amount of travel required.

This same business unit, Sensis, publishes a quarterly consumer report based on a survey of more than a 1000 consumers. I'll lift two findings from the most recent report that shows that consumers are making use of these online services to reduce their fuel usage:

- 44% of customers reported they used online maps to find more efficient routes
- 36% reported they used online directories to find closer suppliers

In closing, I have mentioned just 2 applications of ICT, GIS and GPS to reduce fuel consumption and greenhouse gas emissions. New GIS and GPS applications will need to be developed, and existing ones adopted widely, if we are to curb our reliance on transport fuels. Your contributions as GIS and GPS professionals are needed more than ever before to meet this challenge.

Water Assets Enterprise Gis Development

Using A Modular Approach

Mary Pati, Datec (PNG) and Nepthaly Serebut, PNG Water Board.

Introduction

In 2008, the PNG Water Board, having recognised a need to have a water and waste asset management system commissioned a GIS project to Datec (PNG) Ltd to be it's development partner. PNG

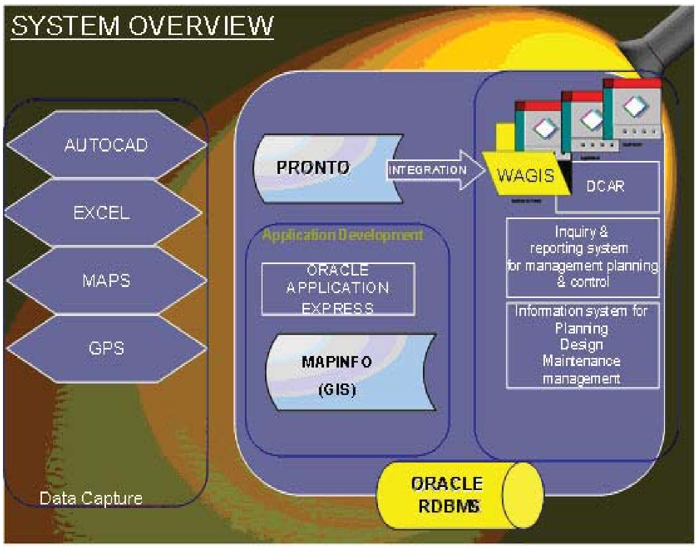

Figure 01: *An overview Water Assets Geographical Information System*

Water Board had two action plans to maintain best practise in asset management;

1. To initiate comprehensive asset audit on all their water and sewerage systems to have an accurate understanding of the true state of all assets in terms of value, performance and residual life, and
2. To establish and maintain a fully integrated asset management system to be able to have a systematic storage of asset information for easy accessibility and an improved pre-active capital asset maintenance, upgrade and replacement planning.

Project Scope

From the initial system design phase through needs assessment, system requirement specifications development and the conceptual design of the Water Assets Geographical Information System (WAGIS), three processes were identified for the WAGIS. The systems identified were the;

3. Drawing Cataloguing and Registration System (DCAR);
4. Planning and design system (PAD); and
5. Assets Maintenance and Management System (AMAM).

The scope of the first module of the WAGIS was identified as;

- development of a WAGIS pilot project for data capture and training
- Oracle, MapInfo and Map Basic installations
- development of the Drawing Cataloguing and Registration system (DCAR)
- development of Pronto and WAGIS interface for management reports and customised thematic maps.

Module 1 – Document Cataloguing and Registration System (DCAR)

Operational Environment

This module dealt with the problem of hardcopy design drawings and plans stored in filing cabinets in the head office in Port Moresby without proper archival system for quicker access and retrieval of the drawings by the various offices throughout Papua New Guinea.

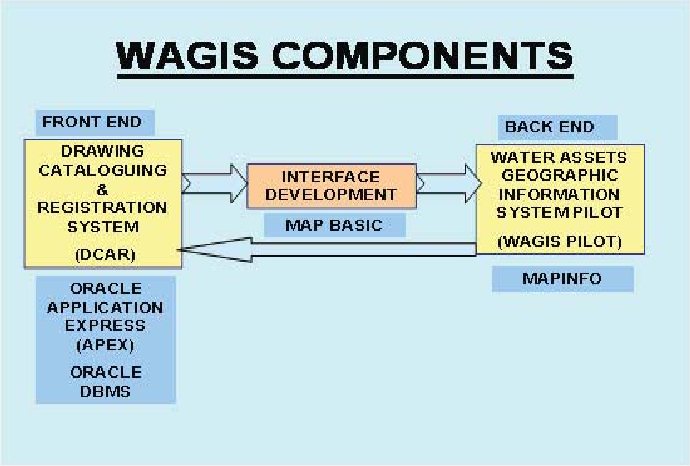

Figure 02: *The main components of the Water Assets Geographical System.*

The APEX or the Oracle Application Express which is browser based and cost effective was used to develop the DCAR. All the manual maps and plans were scanned and uploaded on to the Oracle database. The DCAR automatically assigns a drawing number from the earliest to the latest drawings and plans and categories them as water, sewer or both and miscellaneous for all other drawings.

MapInfo workspaces are also prepared and parameters of plotters are set to print or viewing to required scales and paper sizes with standard title blocks. It is then printed as a pdf document and uploaded onto the database as a pdf document for viewing and printing. These documents can be accessed by all users. The documents can be easily accessed by their offices throughout PNG using various search parameters.

Development Environment

This environment is the area whereby updates and modifications to the WAGIS data layers take place. Upon logon to the DCAR, officers with access rights to updating can view the Map Basic program which launches certain customised MapInfo with updating procedures for the base water and sewer assets tables.

WAGIS Pilot project

The suburb of East Taraka of Lae City was chosen as the pilot project area due to the fact that it had most of the water and sewer assets. The aim of developing the pilot project is three fold;

1. Create the water and sewer assets base tables in MapInfo and to export data from CAD and manual forms,
2. Use the pilot project to train PNG Water board staff on data capture, update and maintenance of the WAGIS database, create thematic maps, and to create and print workspaces.
3. Using the pilot project to draw CAD standards and specifications.

Deliverables

4. Drawing cataloguing and registration system (DCAR)
5. Water assets geographic information system (WAGIS) working area.
6. Water assets geographic interface development
7. PNG Waterboard standards and specifications document.
8. DCAR users guide.
9. WAGIS users guide and data capture procedure
10. DCAR and WAGIS training.

Summary

With the first module completed and operational, it builds the platform for the next module to be developed. The next module will involve a more dynamic environment whereby library templates will be developed for different CAD symbols and standards identified in this module. Designs and drawings will be captured and stored in the database.
The most challenging aspect of this project has been the spatial data capture. A champion has to be identified for the data capture who needs to have a greater commitment to ensure data quality assurance and consistency in the spatial data updates.

Creation, Management and Aeronautical Chart Production Using GIS of Tonga's Domestic Airspace Data

Lara Payne, Peace Corps, Tonga

Recently, the LGIS Section of the Ministry of Lands, Survey, Natural Resources and Environment was asked by Tonga Airports Limited (TAL) to create, house and manage all of the Kingdom's domestic aeronautical data using GIS. TAL supplied the Ministry's LGIS Section with hard copy maps, some flight space parameter criteria and X, Y coordinates of navigational aids and airport reference points to aid LGIS in creation of all the domestic aeronautical GIS data. With only these materials and the utilization of satellite imagery for remote QA/QC the LGIS Section was successful in creating a current and accurate domestic aeronautical GIS dataset for Tonga and

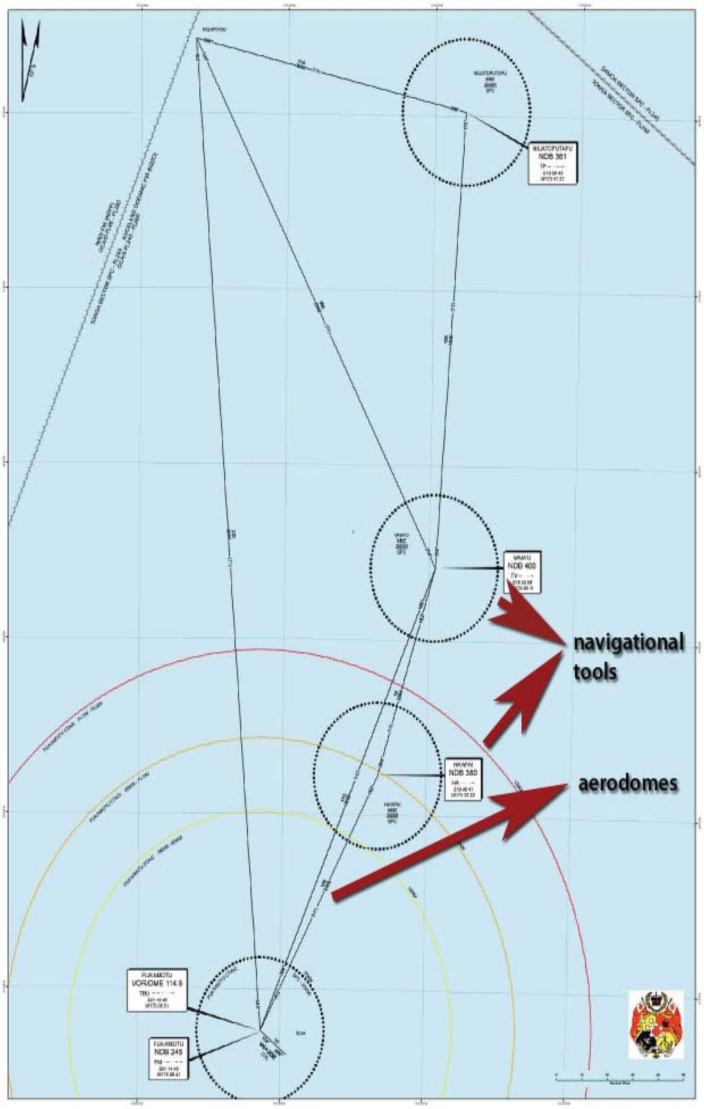

Figure 01:*Completed Tonga Domestic Aeronautical Chart*

Figure 03:*Example of ARP & NAVAID locations in relation to airfield*

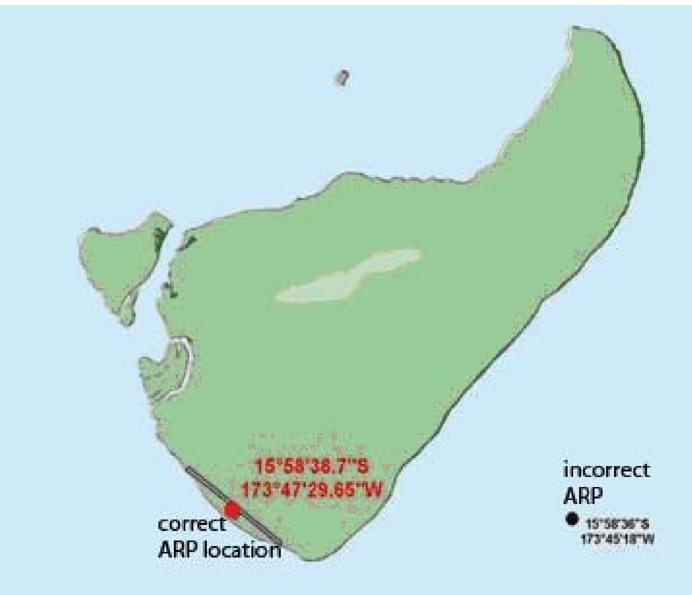

Figure 02: *Erroneous ARP locations for Niuatoputapu Island, Tonga*

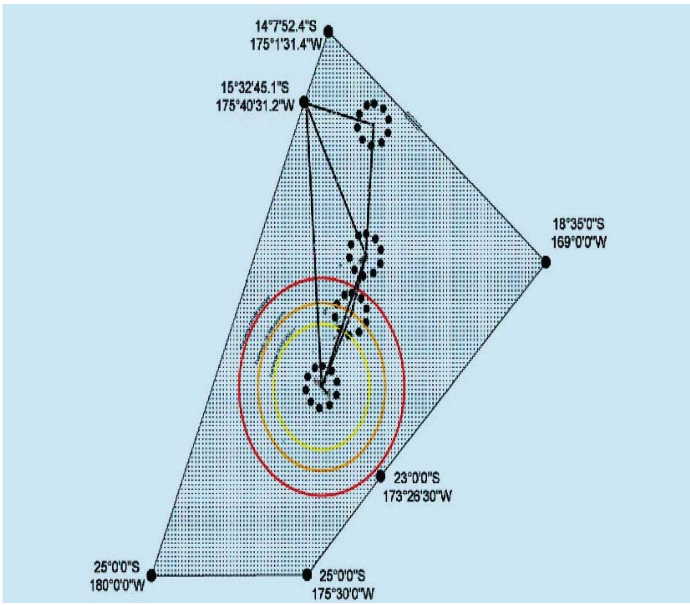

Figure 04:*Example of Tonga Domestic Airspace*

TAL. Additionally, the aeronautical dataset is z–value enabled to enable 3D visualization and modeling.

In order to create the Tonga Domestic Aeronautical GIS data accurate source data for five features had to be collected. Here is a list of those features and definitions:

1. **Airport Reference Points (ARP's)**
- these are the official coordinate values that reference a specific airport
- the most important feature because several of the other feature classes are based on these values.(see Figure 03)

2. **Navigational Aids (NAVAIDS)**
- various types of reference points used by airports and pilots for navigation purposes. (see Figure 1)

3. **Aerodomes**
- these features (See Figure 01) indicate minimum flight height for particular distances from the ARP (25, 75,100 and 130 nautical miles)
- based on ARP points, created with buffers

4. **Domestic Flight Paths**
- linear features indicating minimum flight altitude,
- distance and bearing
- based on ARP's

5. **Domestic Airspace**
- airspace designated to be under the jurisdiction of the Tonga Aviation Authority.

The greatest difficulty with this project was that in many cases the source data information was erroneous and conflicting. Figure 4 demonstrates the discrepancy that was found in the ARP source data information. ARP locations should be closely associated with airstrips so it was evident once the first set of coordinates was input and appeared in the ocean that care needed to be taken with the source data supplied. Correctly identifying the ARP points is vital as the aerodromes and flight path routes are based them. Once the correct input data was obtained and verified the GIS dataset of the 5 feature classes was created. All data creation and processing was done using ArcGIS 9.2 and verified with Quickbird 1 meter resolution satellite imagery. See Figure 5 for an example of the 3D representation of the aeronautical data.

Nadi Flood Mapping Applying TerraSAR-X Image Data.

Wolf Forstreuter, Litia Gaunavou, Elizabeth Whippy, Vilisi Tokalauvere and Joy Papao.

Introduction

From 10th to 11th January 2009, Nadi was flooded to an extent that only occurs every 20 years. The new space-borne image radar technology is able to capture data during cloud cover and heavy rain and provide data suitable for mapping at a 1:10,000 scale. This technology was utilised for flood analyis in the Nadi area

Flood Mapping

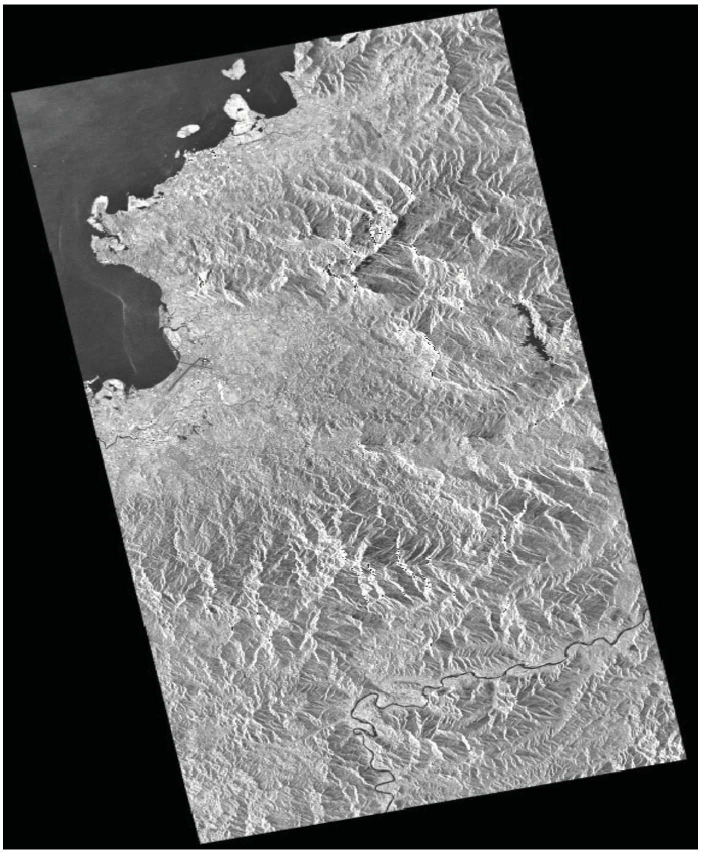

***Figure 02:** Radar Scene captured on 12th January 2009 through TerraSAR-X satellite. The scene covers most of the Nadi river catchment.*

Flood Mapping was done to identify areas and households that are susceptible to flooding. This can either be related to low-lying topography or poor drainage system. During data recording at 18:30 on Monday, 12th January most water had receeded and it was impossible to map the flood extent, however, the remaining water coverage indicates areas that are prone to flooding

Data Sources

Three different data sources were utilised for interpretation and map production: radar satellite image data, high resolution satellite data in optical range and the topographic map 1:50,000.

TerraSAR-X Image Data

The TerraSAR-X image data was captured 6:30 (Greenwich time) on Monday 12th January, which is equivalent to 18:30 Fiji time. This data was downloaded in Kiruna (Sweden) transferred to company Infoterra and from there downloaded through the Internet. The download required 8 and a half hours for 1.6 giga bytes file size.

The image data was available as 8bit GeoTIFF file. ERDAS image analysis software is able to display and analyze TIFF file format. The recording was made as strip mode resampled to 1.3m pixels. TerraSAR-X satellite is equipped with a synthetic aperture radar sensor which sends the beam to the object and analyse the intensity of the reflected signal. The signal response depends on the smoothness and texture of the surface, the angle of the surface towards the sensor and the material of the object.

Figure 02: *Pan-sharpened Quickbird Image data recorded over a period in 2006 with 60cm resolution. This image data was used as reference to rectify the radar data and to digitise the location of houses and infrastructure*

Water bodies of flooded areas have very smooth surface which reflects the beam away from the sensor therefore the areas appear black.

Pan-Sharpened QuickBird Image Data

Pan-sharpened QuickBird data is a synthetic image product by combining the 60cm resolution panchromatic channel of the satellite with the 2.4 metre resolution multi-spectral channel of the same satellite. The image data in Figure 03 was recorded on 6th May 2006. The image data arrived as GeoTiff file projection UTM WGS84, Datum Zone 60 South. Investigations have shown that the data has a shift of several metres compared with GPS measurements of Reference Image Points.

Topographic Map 1:50,000

To classify the road network into categories, the sheet L27 Lautoka of the topographic map series 31 of the Fiji Lands Department was utilised.

Information Layers

The produced map (refer to figure 04 page 5) combines several information layers derived from interpretation and digitising of the QuickBird data and satellite radar data.

Road Network

The road network was digitised from the pan-sharpened QuickBird data and categorised according to the topographic map. The road network is stored into three different MapInfo tables:

1. Main roads;
2. Secondary roads; and
3. Vehicle tracks.

River System/Water Bodies

The river system was digitised from the pan-sharpened QuickBird data and categorised according to the topographic map. Water and lakes and other water bodies were captured as polygons. There are three MapInfo tables:

1. Rivers;
2. Creeks; and
3. Water bodies.

House Location

The centre of the houses were interpreted from the pan-sharpened QuickBird images and a symbol was placed on top of the roof.

Coastline

The coastline was interpreted from the pan-sharpened QuickBird image and stored as polyline.

Flooded Areas
Flooded areas were mapped through different methods as described in the paragraphs below

Flooded Areas Mapped Through Visual Interpretation
The visual interpretation of the TerraSAR-X radar data delineated all areas of low reflectance. Known as tarsealed areas such as the runaway of Nadi Airport were excluded. It is possible that other areas are also tarsealed and not flooded as reference data was missing. The data was captured at three-metre resolution as polygons to fulfil the mapping requirement at 1:10,000 scale.

Flooded Areas Mapped through Semi-automatic Procedures
As described in the semi automatic water body exAs described in the semi-automatic water body extraction chapter, analysis methods were utilised to semi-automatically delineate flooded areas from the image. The advantage is the faster analysis and non-biased interpretation. Resulting in more smaller areas included in the mapping process.

Accuracy
The mapping accuracy is determined by the resolution of the two types of image data, the delineation process and the accuracy of geometric correction.

Accuracy of Projection
The pan-sharpened QuickBird data was received The pan-sharpened QuickBird data was received as geometric corrected data with UTM projection WGS84 spheroid and datum zone 60 South. Tests GPS surveys in 2007 showed that this data is not correct. A set of Referenced Image Points is required to geometrically re-correct the data to be exact at 1:10,000 scale.

The radar data was geometrically corrected in Germany, however data analysis of similar image data in 2008 showed a shift of about 100 metres.

For the mapping procedure, the radar data was rectified and reference to the pan-sharpened QuickBird data which resulted in a linear shift.

Accuracy of Interpretation
During the interpretation of water bodies from the radar data set a zoom factor of 1000 metres was used and areas smaller the one tenth of a hector was attached to the biggest neighboring class. During the semi-automatic data analysis areas smaller the 1000 square metre were also attached to the biggest neighboring class.

The interpretation of the road network and the river system including creeks and other water bodies fulfilled the requirements of 1:10,000 scale thematic mapping.

Steps of Work
This chapter describes the work flow and work process.

Creating Subsets
The subset was delineated from the pan-sharpened QuickBird data covering one map sheet of A0 size at 1:10,000 scale. From the radar data a bigger area was extracted extending the subset of the QuickBird data.

Geometric Image Correction
The radar dataset as rectified and referenced to the pan-sharpened QuickBird data where six Reference Image Points were used; mostly corners of road junctions. Polynomial transformation first order was used to re-calculate the image position. Bilinear interpolation was used as re-sampling method.

Figure 03: *Result of visual delineation of areas covered by water (left) and semi-automatic mapping (right). The semi automatic mapping is much faster (one hour) compared to One and a half days of visual interpretation and it is less biased.*

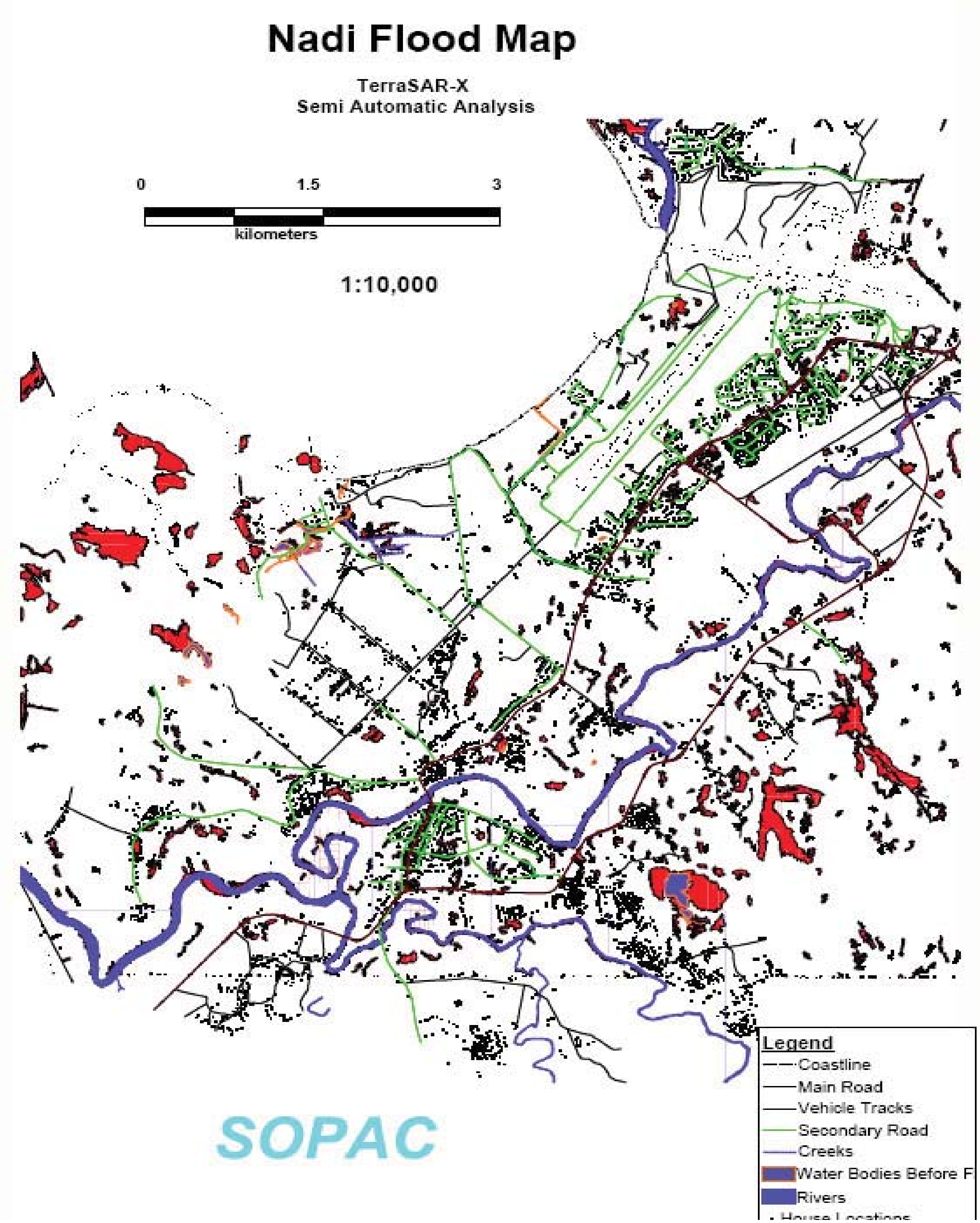

Figure 04: *The resulting map of the mapped flooded areas shows the situation on Monday evening where most of the water had drained. There are still areas covered by water either due to low topography or bad drainage. The areas have been mapped from TerraSAR-X radar data, all other map elements such as roads, river system and house locations were interpreted from pan-sharpened QuickBird data.*

GIS Backdrop Production
The geometrically corrected radar image data as well as the pan-sharpened QuickBird image data was exported as GeoTiff enabling a direct import to MapInfo.

Delineation and Digitizing
The rivers, road network, house location, coastline, and water bodies before the flood were digitised from the screen in the MapInfo environment of the QuickBird image backdrop. The flooded areas were delineated from the radar image.

Semi Automatic Water Body Extraction
To reduce the interpretation time and to perform a non-biased analysis, a semi-automatic water body extraction was tested.

Speckle Suppression
To reduce the salt and pepper effect (speckle) ERDAS provides several filters. The filter used was called “Local Region”, which uses the mean value of the pixels in a local region of a moving window having the lowest variance. The result was a smooth image with reduced speckle.

Density Slicing
As a inter-active process the level between the grey indicating water and non water area was identified on the screen. Through the ERDAS module Spatial Modeler, a program was created which separated the image pixels into water and non water areas.

Image Clustering (Clump)
The resulting image shows many small areas with low reflectance that can be caused by reasons, such as roofs at an angle similar to the radar beam. Water areas can be identified as big pixel clusters of low reflectance.

The ERDAS module Clump can address pixel clusters of same class attached together. The module clump creates an ID for every cluster and stores the information for the number of pixels in a particular cluster.

Elimination of Small Clusters
The ERDAS module Eliminate, was used to convert the class of clusters lower than thousand pixels to the biggest neighboring class.

Raster to Vector Conversion
The ERDAS module Raster to Vector was utilised to convert the cluster to polygons stored as an ArcInfo shape file. The ArcInfo shape file was converted in the MapInfo utility into MapInfo TAB file.

Map Editing and Printing
All described layers were displayed in a map window layout. Scale bar, title and legend were added and converted to PDF file format. It was possible to print the map directly from MapInfo environment as only vector layers were involved keeping the file size small.

Conclusion and Recommendations
The visual image interpretation of flooded areas required one and a half day of work. The digitising of road network, river system and house location is slightly faster but also required two additional people working in parallel. If these features are available as digital layers and if the described semi-automatic flood area extraction is used, the analysis time would be reduced to one hour. It is recommended that all houses located in low-lying areas as well infrastructures are available in digital format.

The programming of the satellite was too late due to a delay in request from Fiji. As a result, the recording was not at the high peak of the flooding.
To ensure that the satellite data is recorded at the peak of the flood, the data acquisition order has to be placed on time.
It is therefore essential that the disaster management office directly informs the SOPAC GIS&RS section during the rising of the flood.

SOPAC has to have access to funding resources for the image data, therefore it is recommended that there is a permanent flood response fund available for image data aquisition.

Reference Image Points Collection and Image Rectification of Pohnpei

Elizabeth Whippy, Vilisi Tokalauvere
and Litea Biukoto

Introduction
The pansharpened QuickBird image (hereafter will be referred to as satellite image) of Pohnpei is a 60 cm resolution satellite image purchased through the SOPAC-EU project. This satellite image comes in geo-referenced but, the average shift amount to about 12 meters.

To correct this shift, a survey of different Reference Image Points (RIPs) around the island was established. Survey grade Global Positioning System (GPS) as used to achieve the scale required for correcting the image.

Pre-selection of RIPs

A 1km grid was drawn on the satellite image. Within a space of 1km, a potential RIP was identified and digitised using a zoom window of 0.5 km, refer to figure 02. Around the urban areas, corners of fences, road marking, corners of jetties were the dominant features; however, when moving into the peri-urban and rural areas, roof corners are the only physical features clearly shown on the satellite image. Once the RIPs were identified and digitised, the maps were printed onto an A3 size paper, which were later used in the field as a guide to identify the RIPs, refer to figure 03.

Base Station Setup

The benchmark were identified to set the base station up and coordinates provided by lands department The benchmarks were chosen over observing the base station points for 24 hours as they are tied into other benchmarks and referenced to a known datum used by the Lands Department.The base station was set up sitting on a levelled position on top of the bench mark during the survey, refer to figure 4. It was taken out daily when the survey was completed and restored the following day

Identification of RIPs in the Field

The Printed map was used as reference to identify the RIPs on the ground. Having the printed map was important as it marked which corner of the feature to be captured. In some cases the actual RIPs was difficult to locate, hence other features in the A3 paper was used as reference like the colour of the houses, road junctions, nearest house to identify the correct RIP. If the RIP was not found, a new one was captured and marked on the map.

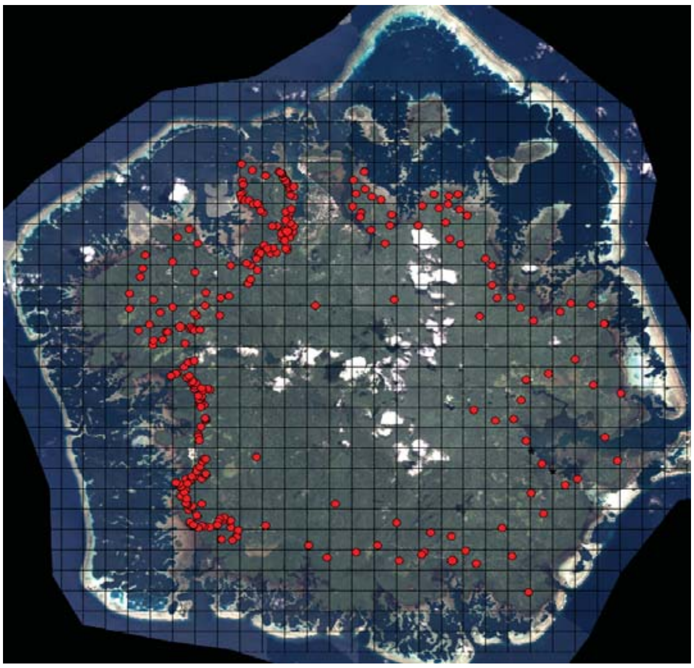

***Figure 02:Satellite** Image and RIPs location*

***Figure 03**: A 1 km grid drawn on top of the image with the Identified RIP in red dots*

Capturing of RIPs

The RIPs were captured using the RTK GPS. Each RIPs were observed from 7 – 45 minutes depending on the number of satellites and geometry. The observation of the point is longer when satellites in view are not sufficient and the PDOP is high; however under good condition when sufficient satellites were in view and PDOP was low, observation time of a particular RIP was shortened.

Pre-processing

Each day the Data was downloaded from the rover using the Trimble Business Centre software and the baseline calculation was applied to correct the image at a sub metre level. This was important to verify the data is captured before the team move to the next area. The data was then exported to MapInfo and exported as DXF readable in ERDAS. The DXF files were imported from ERDAS using the Export/Import function which converts the DXF data into annotation, a readable file in ERDAS format

The satellite image was then corrected using the RIPs as a reference and using Polynomial order 2 as the transformation tool to correct the shift in the image.

Results

At the end of the Survey, one hundred and five RIPs were collected around the island and the satellite image data was corrected to a 1/2 meter shift.

Conclusions and Recommendations

The collection of RIPs is suitable for rectifying the

Figure 05: *Setting up the base station on a known point*

satellite image which resulted in mapping up to 1: 5, 00 scale. The maps could be used for backdrops to update maps of roads, utility assets and houses etc.
The Satellite image could be corrected using the rubber sheeting tool to decrease the error from ½ meter to zero. To have these RIPs as image reference points it is recommended that the base station to be observed for 24 hours and baseline recalculated.

Habitat Mapping of Aitutaki, Cook Islands

By Sharma, A., Kruger, J., Kumar, S., Roelfsema, C., Leiper, I., Phinn, S., George, N. and Story, R.

SOPAC needed a benthic habitat map of Aitutaki Reef, Cook Islands to use as a base map to determine the possible impacts of changes in reef hydrodynamics resulting from increasing the size and depth of the major boating channel. A starting point or "baseline" inventory of resources was important in order to provide evidence of change in the ecosystem. Habitat maps are designed to be used to understand and predict moderate depth (~10 - 20m) benthic habitats for different organisms that inhabit coral reef ecosystems, providing a baseline inventory as an important tool in assessing change in coral reef ecosystems and allowing scientists to spatially document the location of corals, percentage of coral cover, and relative overall health of the system.

Habitat mapping in Aitutaki was carried out in April, 2008. The habitat map was created from visual interpretation of the Quickbird image with a 2.4 m resolution (Fig.1). The image was geo-rectified using control points in the lagoon and on the islands (Fig. 2). Radiometric, atmospheric, and geometric corrections were applied to the Quickbird imagery to derive at-surface radiance image data, capable of integration with field survey data.

A Garmin hand held GPS contained in a dry bag towed by the habitat mapper was used to collect positional data for the photographs taken during transects (Fig.3). The photos were later georeferenced using Quantum GIS software.

A Classification scheme was developed for photo analysis and Coral Point Count (CPCe) was used to classify the photos into different mapping categories (e.g. coral, algae, sand etc). Areas of interest (AOI's) were manually digitised with MAPINFO using the field data and image data as a backdrop. Reflectance signatures were extracted from the satellite image for the AOI's, enabling a characteristic "spectral radiance signature" to be defined for benthic community cover types. Mapping process was performed using the software programs ARCGIS and ERDAS Imagine, and was adjusted to also perform using MAPINFO and ERDAS Imagine. A habitat map of accuracy 60% was produced.

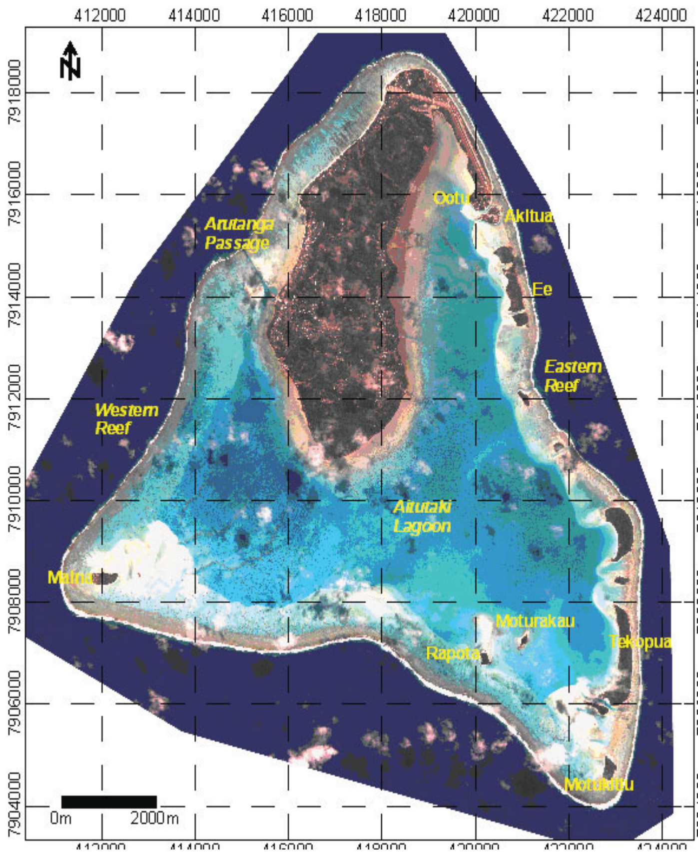

Figure 01: *Satellite image of Aitutaki Lagoon. Satellite image is a Quickbird image with a 2.4 m resolution taken in July 2007*

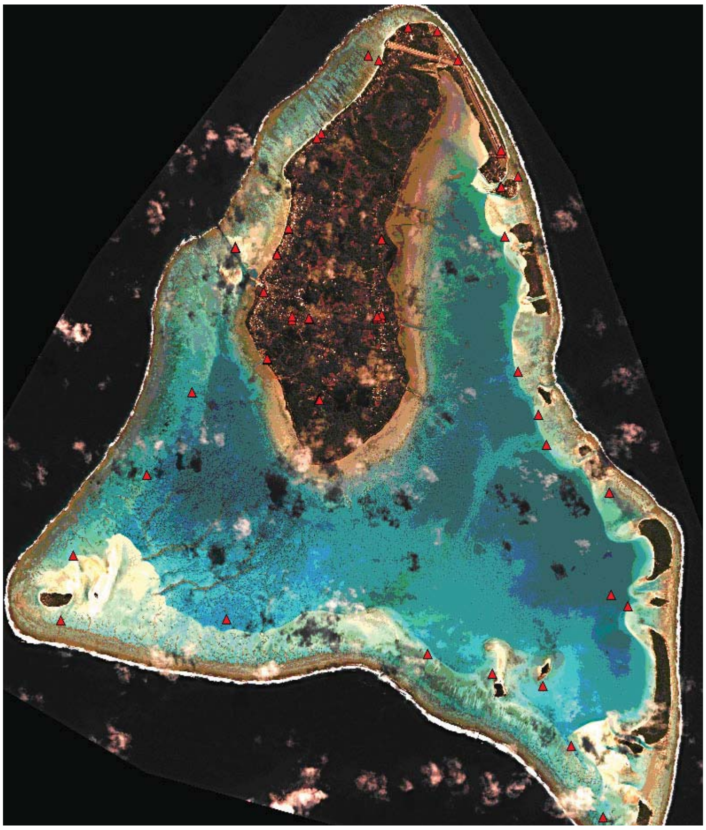

Figure 02: *Reference Image Points around the atoll*

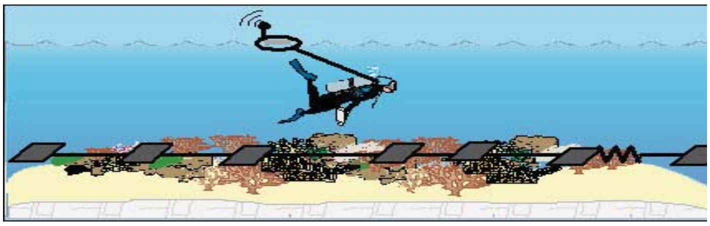

Figure 03:*Diver taking benthic photos at regular intervals and depth.*

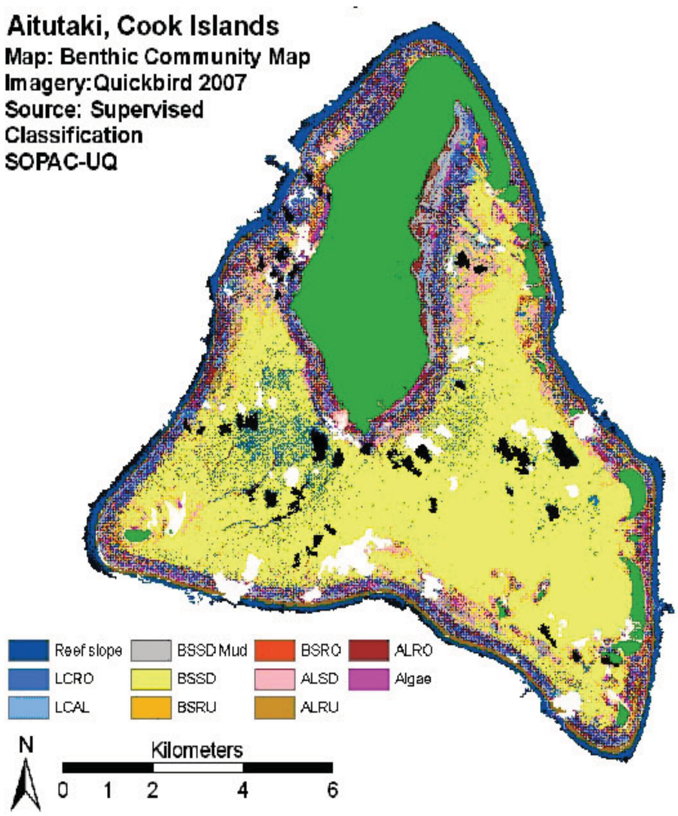

Figure 04:*Benthic habitat map of Aitutaki, Cook Islands.*

This work was initiated by the Pacific Islands Applied Geoscience Commission (SOPAC) and European Union (EU) Reducing Vulnerability of Pacific ACP States Project in conjunction with consultants from the University of Queensland. In addition to the Habitat maps presented in this report and their relevance to the SOPAC/EU project, it is envisaged that data from the survey will be used to support activities in fisheries, mineral exploration, coastal management, and geo-hazard studies.

SOPAC Establishes Contacts with KOMSAT-2

SOPAC has in the past had difficulties in acquiring image data from dealers because GeoEye, QuickBird and IKONOS were booked out. SOPAC has established contact with another source of data: KompSat-2, a Korean satellite with similar specifications as IKONOS.

Pan: 500 – 900 nm.
MS1 (blue): 450 – 520 nm.
MS2 (green): 520 – 600 nm.
MS3 (red): 630 – 690 nm.
MS4 (near-infrared): 760 – 900 nm.
Simultaneous acquisition of Pan and MS allow acquisition of pan-sharpened 1-m images. The sensor covers a footprint of 15 km x 15 km.