The Newsletter of the GIS&RS Users in the Pacific

PACIFIC ISLAND COUNTRIES GIS/RS USER CONFERENCE

Pacific Islands GIS&RS NEWSLETTER

New Start of Pacific Islands GIS&RS Newsletter

More than two years ago we published the last Pacific Islands GIS&RS Newsletter. Now, we have a new team and will publish in regular intervals again. We also have to re-establish the distributing network as many GIS and RS users will not be able to download the PDF version from the Internet.

During the last few years changes have happened in the world of GIS and RS application as new type of data is available and also new software and hardware to handle it. Essential is the new quality of space borne image data where satellites like WorldView-1, GeoEye and WorldView-2 have increased their geo-accuracy due to more precise position capture during data recording through enhanced on board GPS and star tracker. Also the spatial resolution of these optical range satellites has further increased just that this is not delivered outside US. The increased radiometric resolution allows better stratification of vegetation; data of WorldView-2 now covers eight spectral bands where three visible and one near infrared was the norm before.

The increase in data quality induced an increase in pre-processing needs of data to fully utilise the provided information. Image data is in nowadays ortho-rectified, haze is removed through special software and atmospheric correction is applied utilising a digital elevation model to address the relief related atmospheric disturbances, which is essential for volcanic island countries surrounded by large areas of sea. To provide Pacific users with such enhanced data the pan-sharpening process is carried out at SOPAC as it is not possible to improve already pan-sharpened image data in this way. The improved image quality results in an increased image utilisation for different applications. Here a shift is noticeable from just simple backdrops mainly for utilities to a range of different backdrop products from the same dataset. The latter is used for vegetation and land cover mapping, where the interpreter toggles between the different backdrops during the image interpretation.

This newsletter and the following releases will again inform about the new image data not limited to optical range, the enhancement technics, the new application methods and hard ware or software development.

The team is happy to receive articles from Pacific island GIS and RS users as we want raise the information level within Pacific Island Countries.

Wolf

The editorial team from left to right, Naomi Jackson, Salote Baleisuva, Sharon Boe and Wolf Forstreuter. Not on the photo is Sailesh Kumar Sen who is also part of the team.

Need and New Design of Reference Image Points (RIP) for Digital Surface Models

"Reference Image Points" are ground control points or points for which X and Y coordinates are known and which are visible on the image. RIP have been established for Pacific islands to be able to rectify very high resolution image data, which are often do not fit into the projection even if they are purchased as geocoded products. The RIPs established are documented and placed on the web for everybody's use. How to establish RIP is described in Pacific Islands GIS&RS Newsletter at SPC-SOPAC website.

New Demand for RIP

RIPs have been used to geometrically re-correct very high resolution (VHR) image data when producing image backdrops at 1:5,000 scale with metre accuracy. Now VHR image data will be also utilised to create digital surface models (DSM) at 1:10,000 scale level with 3-5 m contour line intervals. It is possible to calculate DSM from stereo images. SPC-SOPAC is official re-seller for DigitalGlobe and currently a stereo pair is offered to a price of only USD 15 per km^2 for the image data. The DSM calculation also needs RIP, however, the original design has to be changed as additional to the X and Y coordinates also the Z coordinate is required.

New Measurement Method for RIP

The first DSM derived from VHR stereo image data was created for a part of Samoa using GeoEye image data. Not all RIPs collected were usable as the height was only measured in the way required for exact X and Y position not sufficient to determine the exact Z position. Normally roof corners are an ideal feature for RIP as they are clearly visible in image data and the position can be determined easily with survey grade GPS equipment (see figure 1). New is that the for the Z position determination a) the distance between antenna and roof corner and b) the distance of roof corner to the ground has to be measured in cm precision. The latter is essential for image data

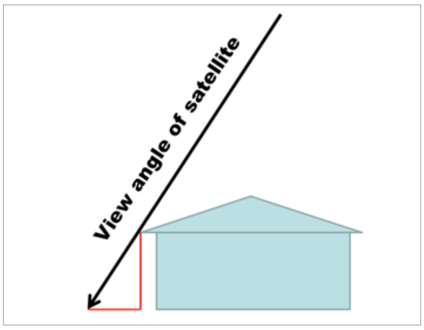

Figure 1: A roof corner as reference image point on the image data and during the survey. To determine the height position the distance between roof corner and antenna and the distance between roof corner and ground has to be measured.

not recorded from the nadir, where the displacement has to be calculated from the sensor angle (see figure 2) and distance between roof corner and ground. Optimal RIPs are collected directly on the ground such as runway or street marker but these features are often not available in outer islands.

Software Requirements

Survey grade software is required for calculating the RIPs position which is available at SPC-SOPAC. The establishment of DSMs also requires software which semi automatically identifies points visible in both images of the stereo pair and subsequently establishes a virtual digital surface model. The RIPs are then necessary to perform the absolute orientation of the virtual DSM towards a known projection e.g. UTM WGS84. Such software is currently not available at SPC-SOPAC. It can be purchased as add on package to available image analysis software. It also would require training of SPC-SOPAC staff as the process of DSM generation requires the understanding of photogrammetric procedures.

Requirements from Pacific Island States to Establish RIPs and DSMs

RIPs are required for several applications where only image rectification and absolute orientation of DSMs are discussed in the presentation. If survey grade GPS equipment is utilised in Pacific island states it is often only a little additional effort to establish a few RIPs. Corresponding departments in Pacific Island Countries have to request for training in RIP establishment. DSM establishment requires software and capacity building at SPC-SOPAC which only can be put into the annual work plan if there is a request from Pacific island states for DSMs. DSMs at 1:10,000 scale are mainly necessary for atoll countries where corresponding countries have to launch requests.

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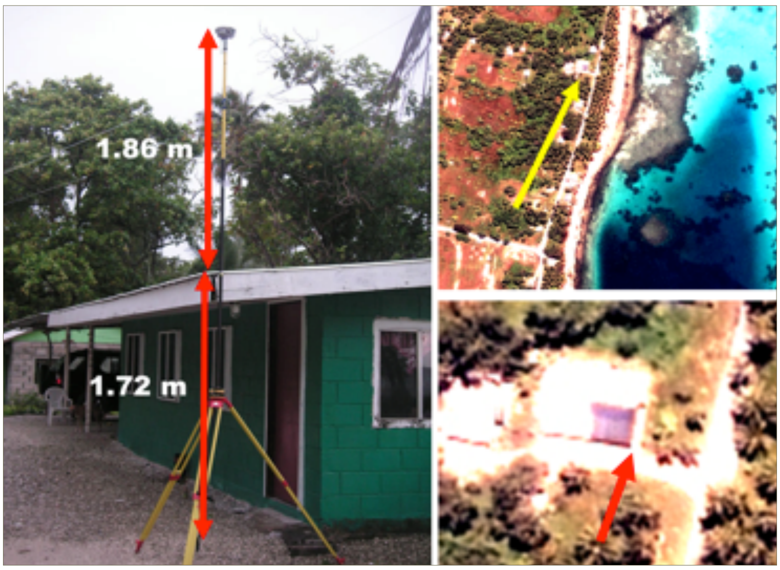
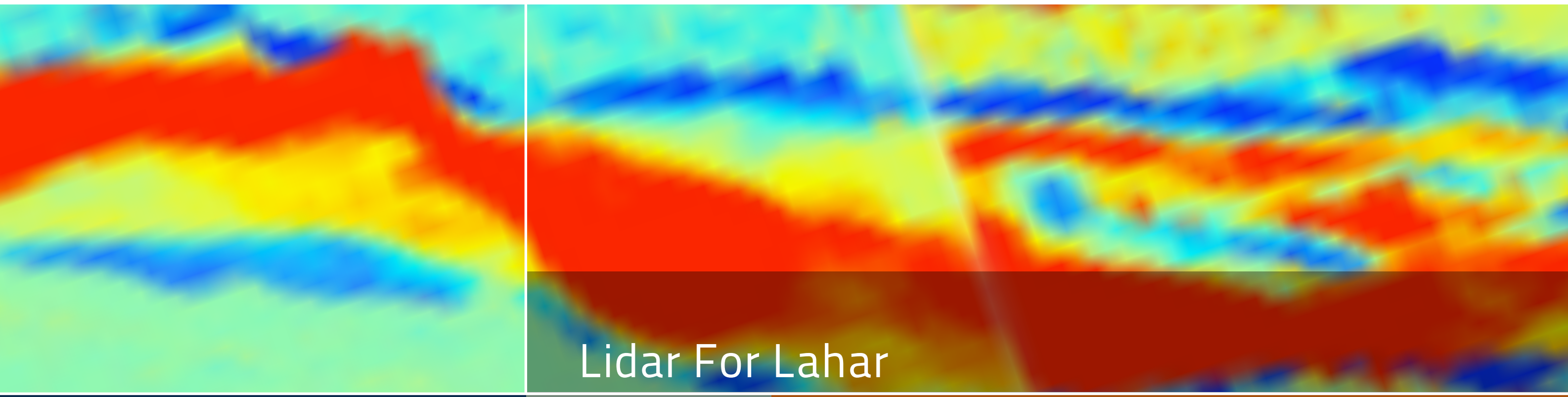


Figure 2: The distance between ground and roof corner has to be known to calculate with the view angle the displacement of the RIP.



Lidar For Lahar

LiDAR has come of age and as with all technological advances, humans seem to find ever increasing numbers of things to do with it. The accuracy and repeatability of LiDAR surveys is now entering the legendary arena, so how can these attributes help us in the world of volcanic hazards?

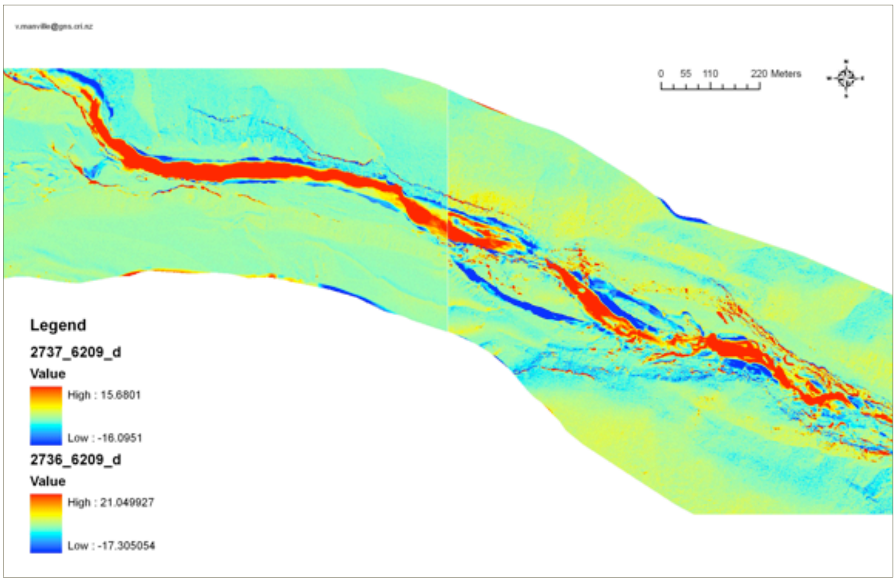
At Mt Ruapehu, in the central North Island of New Zealand, a series of eruptions in 1995 and 1996 expelled the summit Crater Lake, generating a sequence of lahars. Early in 1996, the potential for a significant Crater Lake break-out lahar was identified as the Crater Lake began to refill behind a fragile barrier of volcanic material, or tephra.

A lahar is a rapidly flowing mixture of rock debris, sand, silt and water (other than normal stream flow) originating from a volcano, typically along a river valley. It has the consistency of concrete: fluid when moving, then solid when stopped and can be extremely dangerous, because of its energy and speed.

The threat of such a lahar was taken very seriously as the last time this situation occurred, in December 1953, a major lahar destroyed the Tangiwai Rail Bridge crossing the Whangaehu River at the very moment a train was crossing it causing 151 deaths.

The Whangaehu valley is one of the most active lahar channels in the world, with more than 46 events being recorded since 1861. In addition, eruption-triggered lahars have also passed through New Zealand's largest and biggest ski area on the northern slopes of the volcano.

As the lake rose above the base of the tephra dam in early 2007 it became a matter of when, not if, the lahar would



occur. The worst possible scenario in these circumstances was sudden collapse of the new tephra dam causing a lahar as large as or bigger than the 1953 Tangiwai lahar.

Nowadays, Mt Ruapehu and the sister peaks of Ngauruhoe and Tongariro are constantly monitored by GNS Science, based at the Wairakei Research Centre, just north of Taupo in an area of abundant geothermal activity. A team of New Zealand and international researchers led by Dr Vern Manville from GNS Science and Dr Shane Cronin from Massey University designed and installed a dedicated lahar monitoring system 14km upstream of the bridge to capture maximum benefit from this rare natural event.

One component of this research plan was the need to produce a highly accurate three-dimensional map of the predicted lahar path along the upper Whangaehu River both before the lahar occurred, and most critically immediately afterwards. The specific requirements of the data needed led the researchers to consider the use of LiDAR equipment. Not only would it allow them to map the probable extent of the lahar over a large area at an unprecedented level of detail but it would also give them the vital before/after scenario if data could be collected before and immediately after the event.

The pre lahar data was flown on 18th February 2006 then over one year later, the tephra dam failed on the morning of 18th March 2007, releasing 1.3 million cubic metres of warm acidic lake water. The torrent poured down the steep upper gorge of the Whangaehu valley at 30 km/hr. The lahar passed Tangiwai, 40 km downstream within 2 hours and reached the coast 155 km away in the early hours of the following morning. No lives were lost and infrastructural damage was minimal.

Within less than three weeks of the lahar the post-lahar survey was performed, on 6th April 2007. The post lahar data was captured with an Optech ALTM 3100EA by NZ Aerial Mapping Limited. In addition to the LiDAR data, digital imagery was also captured by the co-sited medium format camera.

This imagery provided both checking imagery for the LiDAR classification and also a set of orthophoto images for eventual supply.

For the processing, the LiDAR sensor positioning and orientation (POS) was determined using the collected GPS/IMU datasets and Applanix POSPac software. This work was all undertaken using NZGD2000 coordinate system.

The POS data was combined with the LiDAR range files and used to generate LiDAR point clouds in NZTM map projection but NZGD2000 ellipsoidal heights. This process was undertaken using Optech REALM LiDAR processing software. The data was checked for completeness of coverage then the relative fit of data in the overlap between strips was checked. The point cloud data was then classified into ground, first and intermediate returns using automated routines tailored to the project landcover and terrain. This and subsequent steps were undertaken using TerraSolid LiDAR processing software modules TerraScan, TerraPhoto and TerraModeler.

Comprehensive manual editing of the LiDAR point cloud data was undertaken to increase the quality of the automatically classified ground point dataset. This editing involved visually checking over the data and changing the classification of points into and out of the ground point dataset. As part of this process LiDAR returns from water bodies were removed from the ground point dataset. The orthophotos were used as a backdrop when undertaking the manual editing.

Independent of the aerial acquisition work, Opus International Consultants field surveyed a series of check sites in open ground, to be later used to verify the accuracy of the processed datasets. Sites were chosen outside of the lahar flow path.

The height accuracy of the processed data was checked using the provided check site data. This was done by calculating height difference statistics between a TIN of the LIDAR ground points and the checkpoints. The standard deviation statistic of the height differences was +/-0.11m.

Captured LiDAR data was processed for delivery into two main sets of data: thinned and unthinned. The thinned data set contained ground classified points only of the entire area and was made up of approximately 45 million points. The unthinned data set was divided into: First of Many, Intermediate, Only & Last of Many and Water Point Cloud and consisted of approximately 87 million points.

Analysis of the pre and post lahar data sets has provided a never before insight into the behaviour and outcome of this lahar. Most significantly for this particular event was the realisation that the lahar was approximately 25% larger than the 1953 Tangiwai lahar.

The oblique photographs show the edge of the terrace scoured back by approximately 20 metres and the valley filled to a depth of 12 – 14 metres. A large amount of the debris within the valley came from a lahar triggered landslide about 500m downstream from the Crater Lake that was eroded by the outflow and contributed significantly to its bulking. It is estimated the volume deficit in the land slide is between 500 – 800,000 m3.

The landslide and all other scoured areas are shown as blue areas within the following graphic which was created by subtracting one LiDAR data set from the other. Blue colouration indicated scouring whilst red indicates aggradation. The oblique photographs were taken of the area in the top left hand corner of this graphic.

The use of the LiDAR data has allowed an accurate model of erosion and aggradation to be established along the entire route of the lahar effect. This has given researchers valuable insight into the behaviour characteristics of lahar and in this instance has raised international interest with this data being studied by scientists in Hawaii, Japan, France and the UK.

David Napier

New Image Pre-Processing for 8 band bundle WorldView-2 Image Data

On the 8th October 2009 a new second next-generation Worldview-2 satellite was launched by DigitalGlobe: it represents the latest innovation among sensors for the acquisition of remote sensed imagery. It has an advanced agility due to control moment gyros (like Worldview-1) and combines an average revisiting time of 1.1 days around the globe with a large scale collection capacity. Moreover, in addition to the standard panchromatic and multispectral BLUE, GREEN, RED and NEAR INFRARED (NIR1) it also the first commercial satellite able to provide an additional 8-band multispectral imagery at 1.84 m spatial resolution. The additional Worldview-2 bands are:

1. a shorter wavelength blue band, COASTAL, ranging from 400 to 450 nm, planned for bathymetric studies, for water color analyses and substantially influenced by atmospheric scattering;
2. a YELLOW band, ranging from 585 to 625 nm, significant for the "Yellowness" of vegetation both on land and water;
3. a RED EDGE band, ranging from 705 to 745 nm, strategically centered at the onset of the high reflectivity portion of vegetation response so potentially significant in the measurement of plant health;
4. a longer wavelength NEAR INFRARED band (NIR2), ranging from 860 to 1040 nm, partially overlapping the NIR1 band and sensitive to atmospheric water vapour absorption.

The aim of this work is the study of the performance of the whole spectral information offered by the Worldview-2 sensor for the characterization and the classification of some selected land cover classes.

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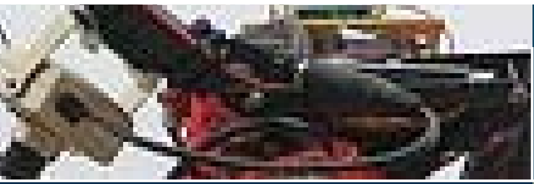

Requirements and Potential of Unmanned Arial Vehicles for Beach Profiles of Pacific Low Lying Islands

Unmanned Arial Vehicles (UAVs) derived from military applications of reconnaissance mapping. These vehicles are increasingly utilised in areas where airborne and space borne image data have limitations. Beach profiles could be a niche market in Pacific Islands Countries as other methods to monitor change of beach surface have limitations.

Beach Profiles

Due to changes of current between el niño and la niña and other reasons the shape of change Pacific islands is permanently changing. This is a natural process in which sand drifts away on one side and accumulates on another side of an island. There is a need to document current land movement in order to predict it in the future. In addition, the impact of sea level rise could be documented in a quantitative way.

Beach profiles have been established through conventional surveying methods in the eighties, where the beach heights were measured along a line established 90 degrees to the coastline. With the launch of IKONOS satellite with sub 5 metre resolution and DGPS survey it was possible to establish accurate reference data of the islands. This reference layer allowed to geometrically correcting historical aerial photographs. Then the change of islands surface has been documented for last decades. RTK GPS provided the source to create a digital elevation model (DEM) of 20 cm contour lines absolutely referenced to the world wide grid UTM WGS84. This can be utilised as a reference to calculate the change in cubic metre volume rather than just documenting the area change when the next RTK GPS survey is carried out.

Requirements and Potential of UAVs

UAVs can be transported from SPC-SOPAC at Suva with the plane as normal baggage like the RTK GPS. It can be re-assembled at the beach and operated by the specialists, where for some systems on the market one specialist is sufficient. The survey itself is very fast as several km of beach profile can be covered within short time, which reduces the time specialists spend on the islands significantly compared with RTK GPS survey.

However, there is some time necessary to prepare each part of beach for the survey:

1) For each survey section about 16 ground control points (GCPs) have to be laid out and surveyed (5 minutes per GCP) with survey grade GPS.
2) There has to be GPS base station with 24 hour survey to identify its own position or it has to be placed on a known surveyed point. If the beach is further away than 15 km from the base station second base station has to be established closed to the survey area;
3) Landing area has to be prepared;
4) UAV has to started and landed, data uploaded and batteries changed.

After each flight the system has to be re-fuelled or batteries have to be changed and data has to be transferred.

The system cannot be operated with stronger winds or rain; however, in opposite to a plane as platform cloudy conditions are more an advantage than disadvantage as the UAV operates below clouds and the light shadow effects are reduced.

Apparently a high resolution camera is sufficient and can be calibrated with the GCPs in the stereo coverage and it is not necessary to have a calibrated camera.

There are two main types of UAVs available a) fixed wing types (see figure 2) and helicopter types (see figure 1). The helicopter types seem to be not that suitable for DTM creation as they have vibration reducing the image sharpness. Fixed wing UAVs need a small landing strip which should not be a problem in most beach environments.

Creating the DTM

To create the DTM an additional investment is necessary, photogrammetric software. There are new companies on the market or software solutions from traditional photogrammetric companies. Important is that the GCPs are clearly visible in about 15 different images recorded during the flight. This requires a) about 80% overlap in flight direction b) about 60% overlap of the strips and c) not less than 4 strips where the central area is utilised. A flight height of slightly over 100m is required by a) the 80% overlap, b) the time intervals the camera shutter can be triggered and c) the pixel resolution of about 2cm. Operating the system without pilot license can be in conflict with this flight height. The flight blocks of four strips have to be rectangular and cannot follow directly the coast line. All these factors are related to the software requirements of creating the DTM and must be taken into account. They have an effect on the cost of running the system economically.

Figure 1: Helicopter type UAV with mounted camera (photo Wikipedia)

Figure 2: Fixed wing type UAV in preparation (company AVI Systems, Poland)

Requirements of Beach DEM Establishment

The DEM established through RTK GPS fulfilled all requirements regarding the beach DEM a) contour lines of 20 to 30 cm intervals, b) UTM WGS84 absolute orientation, c) scale of 1:10,000 to 1:5,000 and d) the possibility to create the first DEM on a laptop computer on the islands for control of completeness. However, the establishment was very time consuming. The DEM requires GPS survey points of a grid of about 4 metre grid cells and about 5 minutes recording at every grid point. The daily area coverage was low. It was not possible to delegate the survey to local specialists as the data post processing at the end of each day requires serious understanding of GPS data and software handling. DEM can also be produced from UAV stereo recording as described below. This also would require only one SOPAC specialist but the system would cover a much larger area at the same time.

Tool or Toy?

Currently beach profile DTMs cannot be created from space borne image data, however, before investing in the technology the cost per km^2 has to be estimated which is not only the investment of the little plane. Factors driving the cost calculation are: a) UAV investment, possibly maximum 100 days/year in operation with an life expectance of two years, b) UAV GPS cost, c) UAV steering software cost, d) Survey grade GPS for GCP establishment, e) investment in software for DTM establishment, f) the high resolution camera, g) cost per hour in the Pacific island of a person with a position at SPC-SOPAC (i) operating and maintaining UAV, (ii) carrying out GPS survey, (iii) operating flight planning software and (iv) operating DTM establishment software, which requires photogrammetric understanding and finally (v) travelling and staying on an outer island.

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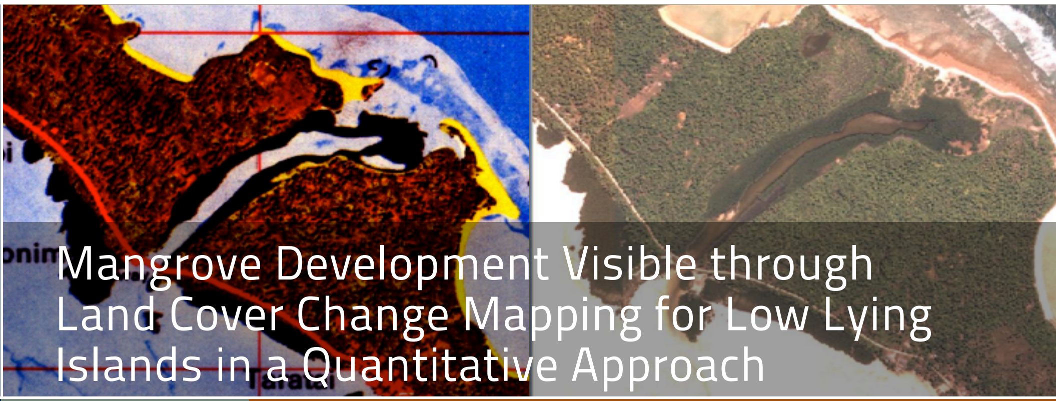

Land cover change in north Tarawa. Left the historical land cover map established from aerial photographs recorded in 1969 and right the recent satellite image showing the actual vegetation cover today. The increase in mangrove area is visible.

Mangrove Development Visible through Land Cover Change Mapping for Low Lying Islands in a Quantitative Approach

During the last three years all islands of Kiribati have been mapped through funding provided by the Forest and Trees Programme at SPC-LRD and several islands have been mapped in Tuvalu through GIZ funding. There are different needs to map the current land cover such as reporting to FAO, food security issues and coconut palm resource management, etc. Utilising historical vegetation or land cover maps created from aerial photographs recorded in 1969 for a comparison also allows seeing the dynamic of land cover change, which can be used as one element of others to predict future development.

Data

Pan-sharpened very high resolution satellite image data is available from QuickBird and GeoEye satellites with 50 to 60 cm resolution geo-referenced to UTM. The vegetation mapping is available as vector data dataset with the land cover classes: (i) mangrove vegetation; (ii) shrub vegetation; (iii) coconut palm cover stratified into three densities; (iv) forest (seldom available); (v) settlement influenced area; (vi) bare land; (vii) inland water bodies.

The historical land cover maps were available in physical form at 1:25,000 scale and after scanning as image data. These maps showed following classes: (i) mangrove; (ii) dry land vegetation which a mixture of shrub; coconut palm; (iii) settlement area, (iv) bare land; (v) inland water bodies.

Method to Map the Change

The image of the scanned map was geometrically rectified with a linear transformation towards the geo-referenced satellite image. Then the vegetation types have been digitised. The resulting vector data have been rasterised with a resolution of 1 square metre per picture element.

The vector data of the satellite image based vegetation mapping were first summarised to the number and content of classes shown on the historical vegetation map. Then the vector data has been rasterised and reduced in resolution to 1 square metre.

As next step an overlay analysis was performed. The values of picture elements of the layer 2009 were multiplied by ten before the value of the corresponding picture elements of the 1969 layer was added and stored a new output layer. This allows quantifying how many square metres of each land cover class were converted into different land cover class and how much stayed stable.

Finally the area statistic was exported to an Access based database.

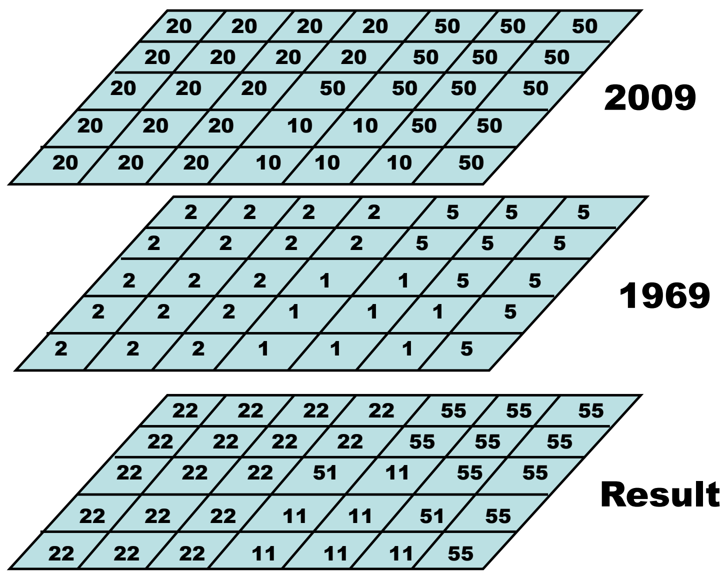

Figure 1: Overlay in raster data environment. The pixel values of the 2009 layer are multiplied by 10 before the values of both layers are added and stored in layer Result. The change can be quantified.

Results

The land cover change was mapped in following islands: Makin, Butaraitari, Marakei, Tarawa, Maiana, Aranuka, Onotoa, Tamana and Arorae. In eight of nine investigated islands the vegetation cover seems to increase only in Makin slight decrease was noted. The increase is mainly in mangrove vegetation followed by coconut palm cover. The increase can have several reasons.

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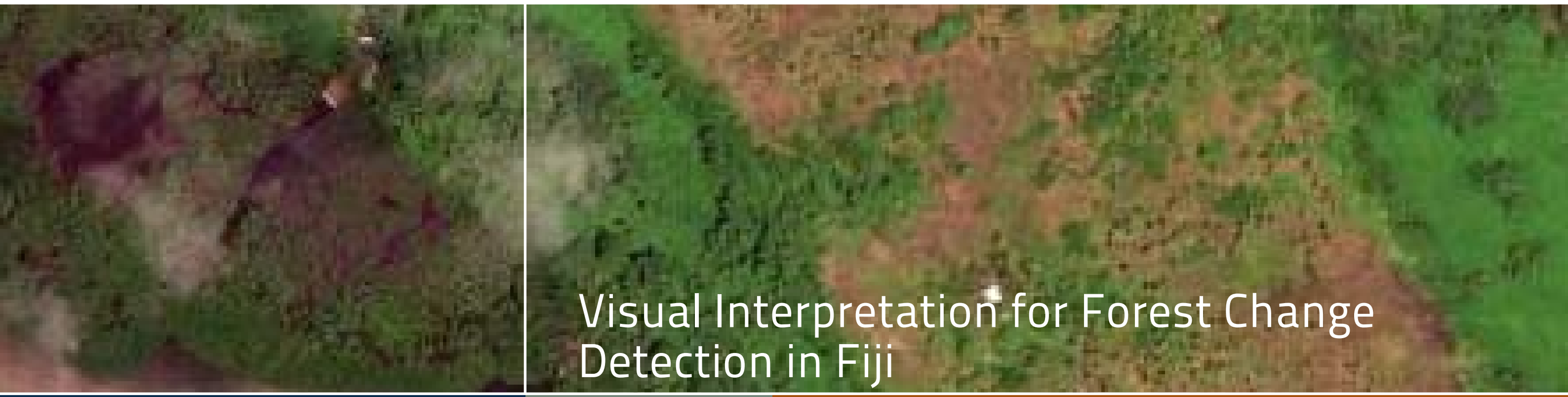

Visual Interpretation for Forest Change Detection in Fiji

This article will discuss why and how the visual interpretation was used as a method for forest change detection exercise in Fiji rather than the semi-automatic image analysis.

The data available included the forest cover layer of 1991. The digital forest layer of 1991 was created through supervised maximum likelihood classification by a company in Germany. Image data of 1991 is limited and had to be downloaded from the internet as original data at the Forestry Department were lost due to storage problems. Also the data which could be downloaded is apparently not the full set of data recorded at this time. Most probably scenes where only small parts are cloud free were not placed on the website. The image processing in 1991 was carried out by a company in Germany which did not detail the list of data utilised.

The visual interpretation was favored due to several reasons. Firstly, the atmospheric conditions in the Pacific are very different to other parts of the world; in certain areas it is very difficult to get image data that is haze or cloud free. The Pacific also has high species diversity. This very time consuming approach was also necessary as both layers showed interpretation problems of possibly different origin.

Both original forest layers were geometrically corrected where the digital river system of the Fiji Lands Department was utilized as reference.

The interpretation is carried out in map sections which are 10 x 10 km areas, where 12 of the sections cover one map sheet. The Forestry department staffs who have a vast field knowledge and experience guided the interpretation. After finishing the interpretation for the 1991 dataset and the 2001 dataset the interpretation continues for the next section. The interpreter starts with the 1991 dataset where he uses the forest cover layer 1991 and corrects it wherever the 1991 image data is cloud free. The interpreter toggles between the natural color (blue, green, red) and the false color infrared (green, red and near infrared) images. The interpreter also notes the image data his interpretation is based on in a corresponding access database and he documents if the image data is cloudy and the digitising is based on the forest cover layer 1991. Plantation areas visible in the forest cover layer 1991 are excluded from the image interpretation. The atmospheric correction was also performed on the images and assisted in reducing the atmospheric differences related to relief and local haze but visual interpretation was still necessary for parts of the images affected by haze.

If the interpretation of the 1991 data is finished for a 10 x 10 km section the interpreter copies the vector file containing the polygons of forest or mangrove cover for 1991 to a corresponding file labelled as 2001. Then he displays the 2001 image data and corrects the polygons wherever the forest has disappeared. The interpreter also records in the database if an area is cloudy in the 2001 dataset and the 1991 forest area cannot be corrected and the image data used. For some areas that were cloudy in the 2001 image data, the interpreter uses the "Google Earth Connection Utility" tool whereby the digitised polygon in mapinfo is exported as "kml" format and automatically opened on Google earth. No changes would be made to the 2001 polygons if the area is still the same according to the latest 2011 cloud free image data available on Google Earth.

The change detection is not based on image data alone as plantation areas were not interpreted regarding the current forest cover and areas covered by clouds in the 1991 data set were digitised from the 1991 forest cover layer.

The analysis of change was performed with ERDAS raster GIS software, where both inventory output layers were combined through Goedel's method. The analysis is based on number of pixels which then is converted to area knowing that each pixel of 25 x 25 m represents 0.0625 hectare. To reduce the 'salt and pepper' effect it was agreed to filter areas smaller than 1 hectare.

A field verification exercise is carried out after analysis in the office, and this allows the interpreter to compare image data and what is really on the ground. The Forestry Department officers who have a vast knowledge and experience in field work are also involved in the field verification.

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GIS for Disaster Risk Management training completed for Fiji DRM practitioners

GIS for Disaster Risk Management training completed for Fiji DRM practitioners The SOPAC Division of SPC in collaboration with the Ministry of Provincial Development and Disaster Management and the Fiji Lands Information System Office successfully conducted a basic training workshop on Geographical Information System (GIS) for Disaster Risk Management from the 12th to the 23rd of March 2012. The main objective of the training was to provide an overview of how GIS could be used as a tool for Disaster Risk applications, to support disaster preparedness and response work and also other potential applications.

Participants of the training included personnel from the National Disaster Management Office, the Development and Planning Units of the Commissioners' Offices, theMinistry of Health and the Department of Public Health at the Fiji National University. The training was important as it contributes to capacity building activities progressing to the Fiji Joint National Disaster Management and Climate National Action Plan supported by AusAID and managed by the SOPAC Division.

The workshop was closed by Mrs Unaisi Bera, the National Adviser on Environmental Health from the Ministry of Health who thanked the NDMO for soliciting support in such capacity building initiatives that will add value to efforts to prevent epidemics after a disaster. She further added that her team in the district and division closely collaborate with disaster coordinators to ensure secondary hazards like epidemics are controlled. The capability to use GIS will enable her team to map areas that lack basic sanitation facilities and provide direct support to prevent epidemics if the same area is affected by a disaster. Also at the closing was the Permanent Secretary of the Ministry of Provincial Development and Disaster Management, Mr Inia Seruiratu, who thanked SOPAC for the timely support and pledged to fully support the initiative by providing dedicated staff to lead the GIS development in the Ministry. He further reminded the participants to apply the new skills acquired in their respective offices to increase their capability in managing disasters effectively. An Advance GIS Training workshop is scheduled for August 2012 to follow up on skills learned during this training session. SOPAC will also provide ongoing technical support to participants in their respective projects in the lead up to the next training session.

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The Fiji Electiricity Authority began work on building its GIS in 2004. With assistance from Sopac, GIS office staff at FEA was trained on data capture techniques using a GPS, working with databases and mapbasic programming to customise MapInfo.

From there the GIS Office continued its field data capture and building the FEA_GIS. To date we have captured just over 90% of our Distribution Network assets, which includes some 78000 power poles.

The FEA_GIS is currently being utilised by our Network Design Team, who look after the extensions and reinforcement to the Distribution grid. They use the GIS to check the locations of customers applying for power in relation to FEA's Distribution Coverage, the closest transformer and size of the transformer and match it against the maximum demand of the consumer applicant. From this they can determine, whether or not they can approve a customer's application for power, or whether there is a need to upgrade the System in that area to cater for the new customer. Most of their preliminary designs are now done in GIS environment, field check is done to verify and confirm other details.

Our Distribution Team, who work on maintaining the lines and ensuring that power reaches the customer also utilise the FEA_GIS to plan and report their maintenance works, switching programs, commissioning works and such.

But the most satisfying I would say, is that the users are grasping the concept of how GIS works and that it can assist them in their daily work, making things easier. For example being able to view the Distrbution Network from your PC, instead of going through layers of hardcopy drawings. Being able to extract details of the Distrbution Network from the GIS, some of which, previously could only be done by going to the field. The GIS Office constantly gets feedbacks from our field staff and others using the GIS, to update us on the changes that are done in the field, the new extensions to the grid. We also get requests on how to extract certain data from the GIS, how to manipulate the map layers and do other queries. Our Distribution and ICT teams have included as part of their work process to inform the GIS office on any changes that is done in the Distribution Network and also on FEA's Optic Fibre Network.

FEA carries out a cyclone power restoration drill during the year before the cyclone season begins. It is also part of the process for the GIS to be set up in our operation centres and boardroom to monitor the progress of power restoration in a cyclone event. This assists in the preparation of daily reports to management, the media and to government officials. These are positive signs that users within the organisation are using the FEA_GIS.

At the end of every year, we normally create a map showing the FEA's Distribution Network in Viti Levu, Vanua Levu and Ovalau. But with the increasing number of rural electrification projects, it was better to see our FEA data against the official Fiji map produced by the Lands Department, which also shows all the villages, schools and hospitals and this can assist FEA in planning the following year's rural extension projects. After discussions with Lands Department, we passed our FEA data to them and they were able to publish it on the 1:200,000 scale map of Viti Levu and Vanua Levu, including Ovalau.

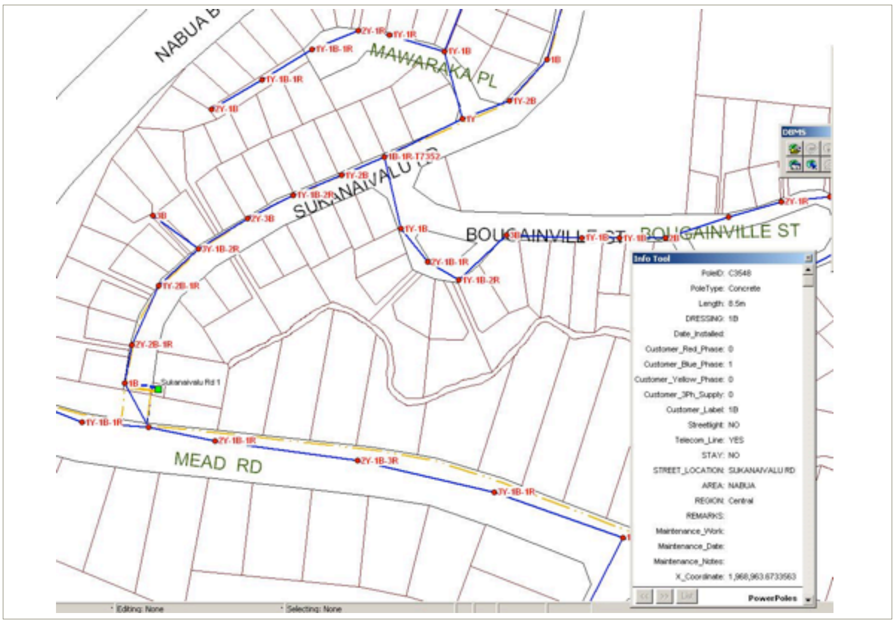

Figure 1. From the FEA_GIS, users can find out details which would they normally have to go out to the field to find out, like pole type, pole length, pole dressing etc.

Lastly, this year we have been working with our System Planning Team, to provide data on conductor types and distances from point to point. This is being used to input into a load flow be considered when doing a load flow analysis. In addition to this FEA is in the process of overhauling its SCADA system, discussions held with potential vendors include possibility of

Date	Feeder	Pole ID	Dressing	Planned/Breakdown	Date GIS Updated
01.07.2011	Nasinu	C8457	11B	Emergency	
01.07.2011	Nasinu	C11433	18B	Emergency	
01.10.2011	Nasinu	C7980	1B	Planned	
01.10.2011	Nasinu	C7979	1B	Planned	
01.18.2011	Nasinu	C8181	4B	Planned	
02.09.2011	Nasinu	C8183	1B	Planned MV	
02.09.2011	Nasinu	C8184	1B	Planned MV	
02.09.2011	Nasinu	C8185	1B	Planned MV	
02.22.2011	Nasinu	T330	Replaced 100kVA transformer, installed 10.2m concrete pole for H pole, installed 2 x 3B and 11B on new pole	Planned HV	

Figure 2. Sample of the condition monitoring forms used by our operations personnel, listing maintenance works being carried out, date and whether it has been passed off to the GIS Team to update or not.

analysis software. Discussions were held a few years back with SOPAC on the possibility of running a load flow analysis on GIS. Research is still ongoing in this area as much needed input is required from electrical engineers on the properties of different conductors and other variables to integrating SCADA with the FEA_GIS. If all works well, we could soon in the near future, be able to view the FEA_GIS in real time.

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