ABSTRACTS OF PAPERS PRESENTED AT THE STAR* SESSION 2008

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Tuvalu Government Buildings, Funafuti

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SOPAC

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Post-Session Version
December 2008

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Note from compilers

Abstracts included in this volume were received up until the close of business on Thursday, 9 October 2008. Abstracts received after that date will be circulated in Funafuti, Tuvalu along with the programme for presentations; and be included in the Post-Session version of the Abstract volume.

FOREWORD

STAR (SOPAC's Science, Technology and Resources network) was founded in 1985 in collaboration with the International Oceanographic Commission. STAR was formed to assist the international geoscience community to continue to provide advice to SOPAC, particularly during the intervals between SOPAC International Workshops. The first Chairman of STAR, Dr Charles Helsley, then Director of the Hawaii Institute of Geophysics, guided STAR until 1992. He was succeeded by Keith Crook from the Hawaii Undersea Research Laboratory. Keith served until the end of 1999 when John Collen from Victoria University became Chair.

STAR meetings are not simply technical conferences at which individuals present scientific papers and discuss their results and implications. Participants have the additional responsibility to formulate advice to SOPAC about its work program and to highlight technical and scientific issues of particular importance or urgency to the region. This advice, in the form of reports and recommendations from STAR Working Groups and reports on highlights of STAR technical presentations, is tendered to Council by way of an address in Plenary by the Chair of STAR and during the Governing Council/Technical Advisory Group (GC/TAG) segment of the Annual Session. All STAR participants are invited and urged to participate in this phase of the meeting.

One of the great strengths of SOPAC is its ability to mobilize excellent and multidisciplinary science and bring it to bear so as to address the national needs of SOPAC's island member countries. The long-established working relationship between SOPAC and the international research community is a vital element in this endeavor, which STAR is charged to nurture. This relationship stimulated an order-of-magnitude change in the geoscience database in the SOPAC region during the 1980's. During the 1990's it supported the changes in SOPAC's scope and focus that led to the development of the three major work programmes and that are still continuing. Since 2005, Programme Monitoring and Evaluation Groups (PMEGs) comprised of TAG scientists, have met with SOPAC Programme Managers prior to the STAR Meeting and then reported directly to Council as independent advisers during the joint TAG/Council deliberations.

In earlier years STAR was primarily concerned with "blue-water" marine geoscience, tectonics and resource exploration and evaluation. However, as national needs and priorities have changed, the scope of STAR has similarly altered, partly reflecting changes in focus of international science but also to ensure that SOPAC's Work Program and its forward planning are influenced by international science that is both excellent and relevant. The wide scope of the work outlined by the abstracts in this volume is a clear indication that this evolution is continuing. The major theme of this year's STAR meeting, "Environmental change and oceanic islands – especially with respect to managing water resources and sanitation on atolls", is very appropriate given the conference venue on Funafuti, and the number of presentations devoted to that theme further emphasize the relevance of this meeting to the Pacific.

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October 2008

ABSTRACTS OF PAPERS

AMBROZ

An economic feasibility assessment of lagoon dredging in Funafuti, Tuvalu

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Finding a sustainable source of aggregate (sand, gravel, rip-rap) is a major concern for many Pacific Island countries. In countries such as Tuvalu, expensive imports are used for large-scale construction while households rely on mining ad hoc from the foreshore and inland. Mining is believed to have negative environmental repercussions – for example, past SOPAC studies have noted the link between aggregate mining and coastal vulnerability. The Government of Tuvalu has expressed interest in investigating the viability of dredging aggregates from Funafuti lagoon in an effort to alleviate reliance on imports and hand mining. SOPAC was requested to conduct a benefit-cost analysis of lagoon dredging. To that end, this report contains a financial and economic assessment of a hypothetical lagoon dredge. The financial assessment investigates whether a lagoon dredge would be financially self-sufficient; that is, whether revenues would exceed costs. The economic assessment compares the socioeconomic costs and benefits under the 'future with dredge' and 'future without dredge' scenarios. It is found that a lagoon dredge would generate profits over a twenty-five year period. Furthermore, the economic internal rate of return is 12%, indicating that a dredging project would generate net economic gains over a twenty-five year period. A sensitivity analysis was conducted to test the robustness of both the financial and economic assessments. These results can be used to inform the Government of Tuvalu's decision making on whether to continue investigating the possibility of lagoon dredging.

BEPAPA

Water governance in Solomon Islands

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Water resources management has been problematic in the Solomon Islands over several decades, with one of the obvious reasons being the limited application of the current River Waters Ordinance 1969. This led the government to request assistant from UNDP in the late 1980s and subsequently, a UN Water Advisor visited Solomon Islands in 1989 and made recommendations for possible water legislation for the country. This was the first steps towards recognising and taking action to improve water governance in the country.

Solomon Islands has faced periods of political instability, which has made it difficult to focus government attention on a single issue such as water. Due to a lack of national policy, legislation and community awareness, water resources management has been fragmented.

Solomon Islands was one of three countries (together with Fiji and Kiribati) to be selected for support by the EU-funded Programme for Water Governance (PfWG). A temporary intersectoral water sector group was established to coordinate the development of draft water policy and

legislation, as well as draft terms of reference for the establishment of a formally endorsed National Water Committee.

Following the termination of the PfWG, the Solomon Islands government highlighted water governance as a priority and decided to allocate funds to continue the process, specifically focussing on consultation and review of the draft National Water Resources Act and the appointment of a dedicated member of staff to further national water policy and planning processes.

The Water Resources Division within the Ministry of Mines, Energy & Rural Electrification is now leading the process of establishing a formal National Water Committee to sustain the intersectoral dialogue for water resources planning and management.

With renewed support from the EU IWRM National Planning Programme, Solomon Islands is building on the lessons learned from the PfWG, to embark on a road towards integrated water resources management and planning on the basis of the proposed National Water Resources Act and Water Sector Policy.

CHAND & Others (Poster)

Wind Characteristics and Resource Assessment around Laucala Bay Area, Suva, Fiji

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Fiji, a group of volcanic islands in the South Pacific, is located between 15°S and 22°S and longitudes 174°E and 177°W, and experiences a variable wind regime in a relatively small area. In this project, wind characteristics and resource assessment for the Laucala Bay area in Suva is investigated using Wind Atlas Analysis and Application Program (WAsP). A micro-scale prediction of wind resource assessment for Nabua is carried out using WAsP. These predictions were based on the digitized map, surface roughness, orography and the obstacle groups present at the Nabua site. According to the WAsP report, Nabua is a poor candidate for wind power generation as it has a mean wind speed of 3.30 m/s and a mean power density of 40 W/m^2. WAsP also shows that if the Whisper 100 turbine is installed at the Nabua site, it would have an AEP of 227 kWh. To validate WAsP prediction, on-site wind data were analysed and it was found that the mean wind speed was 3.05 m/s and a power density of 36 W/m^2. Statistical analysis carried out on these results showed that WAsP had tendency to over-predict wind regime. A resource grid for the greater Suva area was generated using WAsP. It showed that, within the grid there were some potential wind power generation sites, one of such sites being Tamavua Heights. WAsP predicts that Tamavua Heights has an annual wind speed of 13.30 m/s, with a power density of 3286 W/m^2 and an AEP of 3.38 MWh for Whisper 100 turbines

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COCKER

Haze Removal and Atmospheric Correction of Satellite Images

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Haze interference is a frequent when interpreting satellite images especially in Pacific Island Countries where local haze appears in most images due to marine environment influence. Image pre-processing is part of a SOPAC service both haze removal and atmospheric correction will be added. The presentation will demonstrate the effects of haze removal where the haze is semi automatically masked out by the software and as a further step the contrast in these areas is enhanced by adjusting the image features to the contrast outside haze effected areas. The image after the process shows more details enabling better image interpretation. Haze removal does not work over water.

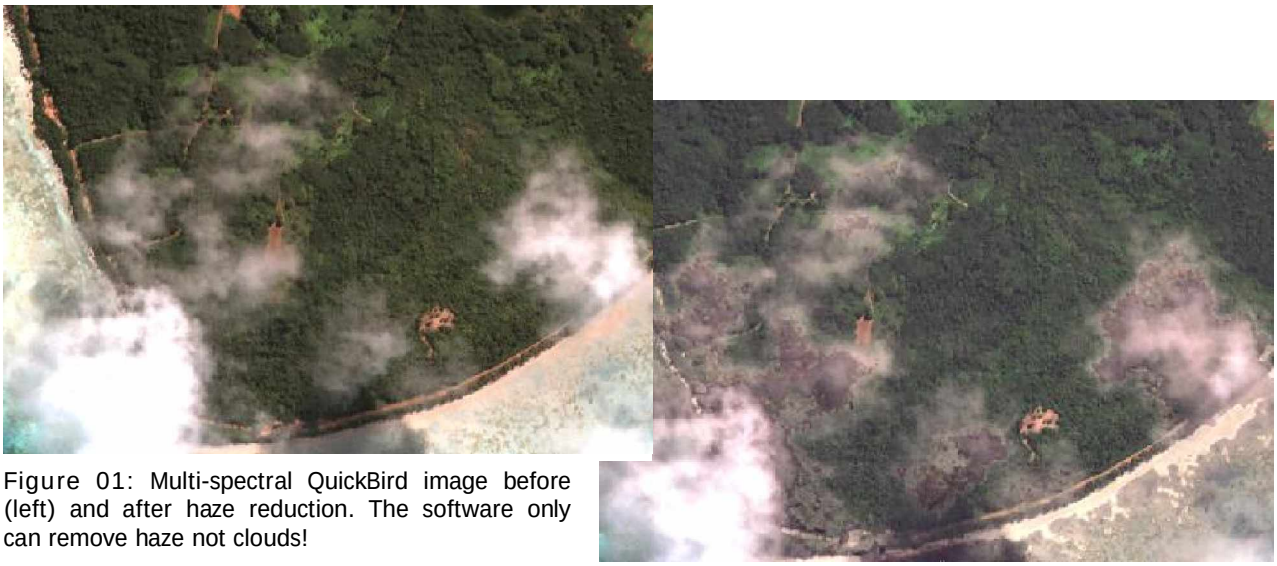

Figure 01: Multi-spectral QuickBird image before (left) and after haze reduction. The software only can remove haze not clouds!

High-resolution images are not recorded at one time and from nadir view like the old generation of satellite image data such as Landsat. The new generation finally provide image data usable for 1:10,000 scale mapping a requirement for most Pacific island Countries where Landsat was restricted to 1:50,000, however, these images are stitched out of different image tiles recorded at different times. To create homogeneous images these influences have to be eliminated as far as possible and atmospheric correction does it. All parameters are taken into account such as view angle, main land cover type, spectral coverage of the sensor, atmospheric conditions of the region, location together with day and time of recording leading to sun angle calculation and regional calibration of the sensor (offset). Then the software calculates the influence of these parameters and subtracts it from the image data. When the corrected image tiles are stitched together the image contrast between the tiles minimises and the image has better overall contrast. Atmospheric correction works also over water bodies. However, both procedures atmospheric correction and haze removal require multi-spectral images they do not work with panchromatic or pan-sharpened image data.

Both haze removal and atmospheric correction were tested at SOPAC and work well. It is now up to the user of SOPAC's member countries to request the service. The presentation explains how haze removal and atmospheric correction works and shows the results.

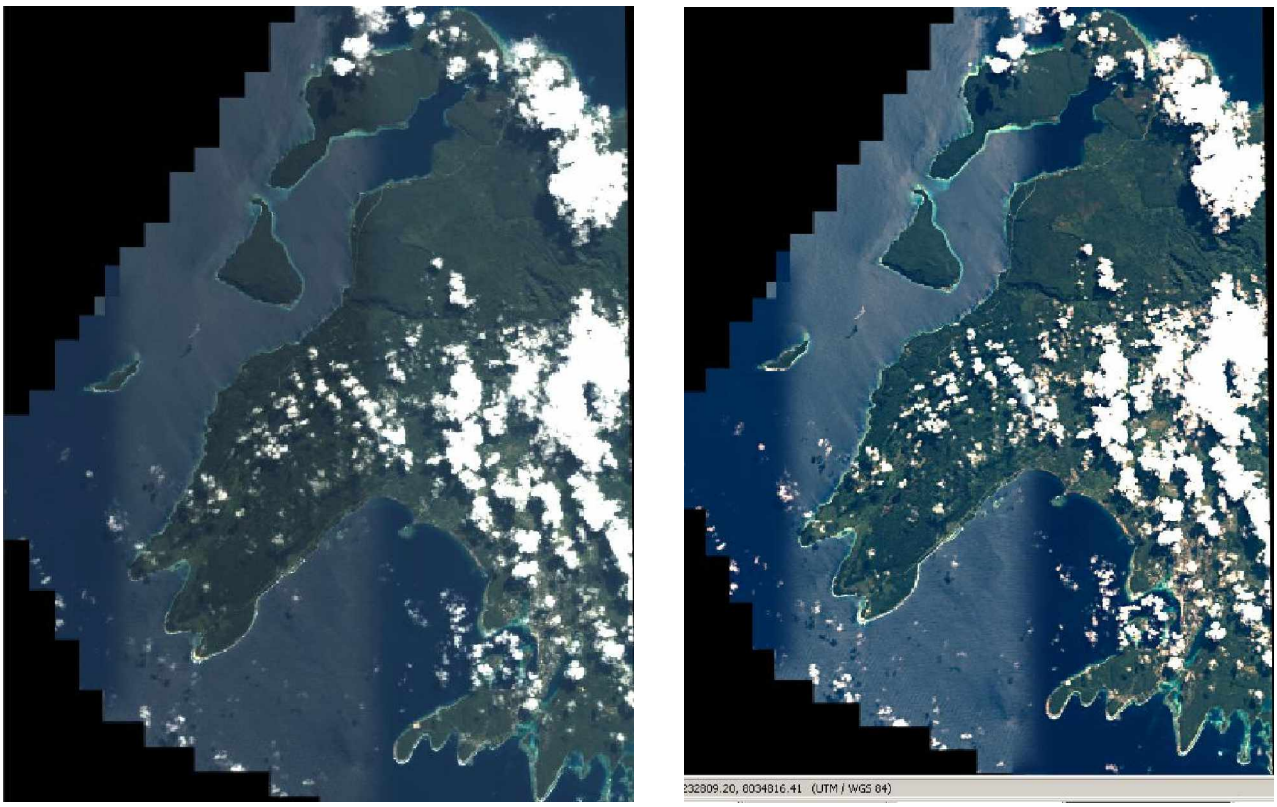

Figure 02: Three QuickBird image tiles mosaiced together. Left: the uncorrected mosaic where the difference in the vegetation area is clearly visible. Right: the same mosaic but atmospheric correction was applied for the tiles before they were stitched together. The difference on land between the tiles is not visible, however, the difference on water areas increases. This will be eliminated through applying the correction for water bodies and land separately.

Shallow Water Bathymetry Utilizing Satellite Images

Many Pacific Island countries are fringed by reefs enclosing shallow water lagoons which are integral parts of their ecosystems. The mapping of these areas can be difficult, time consuming and costly in particular if changes in these areas are to be monitored. Hence the application of Shallow Water Bathymetry Utilizing Satellite Images has provided an alternate option for addressing this issue.

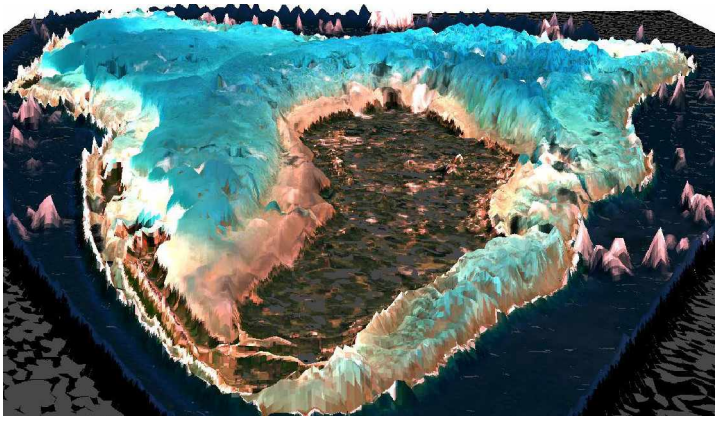

Figure 01: The 3-Dimensional Quickbird Satellite Image of Aitutaki Lagoon, after applying the correlation function of reflectance and depth.

As an example the ability to determine the sea bottom with digital elevation model (DEM), can be useful in order to reduce future tsunami impacts. This can be achieved through modelling to identify areas that are more susceptible to the impact from such events. Government Fisheries and Agricultural Departments can also benefit from sea bottom modelling for marine species habitat mapping, sediment deposition and transportation impacts as

a result of erosion from the land, and other applications that contribute to developing projects for the management of coastal and marine resources.

Satellite sensors measure different levels of energy that penetrate through and are reflected from the earth's surface back into space. The penetration of light through sea and its reflectance into space can be roughly estimated with the function Log of blue divide by Log of green. In developing the methodology the sample data comprised of water depths measured using single beam sensor. These were then compared with reflectance data to determine a correlation function between both data sets. A skeleton of the function was developed in "ERDASś Spatial Modeler" that applied the derived function to each estimated depth from Log of blue over green to compute a more accurate depth. A second sample was extracted from measured depths for comparison with the result so as to further establish levels of confidence and the effectiveness of the methodology.

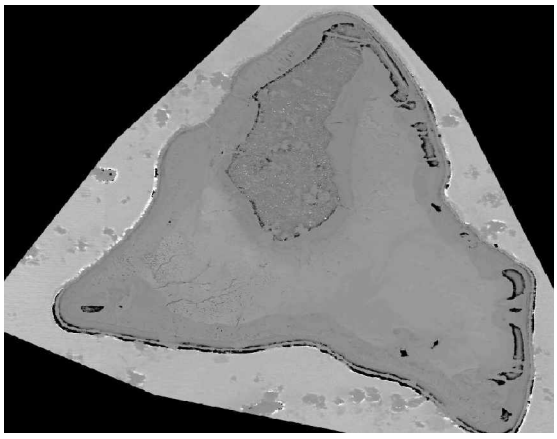

Figure 02: The result of dividing log of blue over log of green that extract estimated depth according to attenuation of light.

Results show that for up to 8 metres of water depth there is a strong correlation between reflectance and water depth. For depths over 8 meter, the levels of confidence and accuracy deteriorate significantly. As for accuracy of the method, the results from comparing measured and derived depth shows more than 70% of derived depths are closer or equal to measured depths.

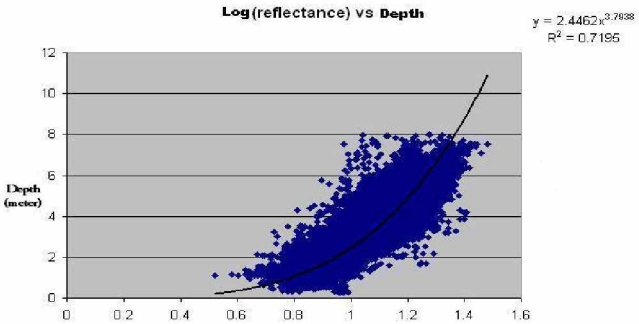

Figure 03: The graph shows the linear correlation between log and depth and the corresponding function.

This method is deemed applicable for use in the Pacific where there are extensive shallow water or lagoon areas although the methodology requires simplification through automation of methods if it is to be utilized extensively in Pacific Island countries.

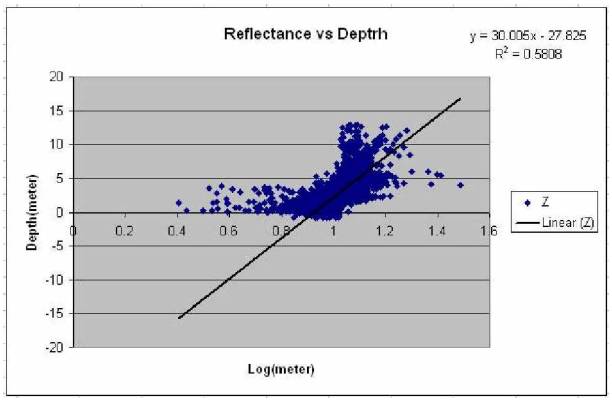

Figure 04: The graph shows correlation power function for depth greater than 0 and less than 8.

COLLEN, GARDNER & Others

Application of the littoral cell concept to managing a protected atoll: Palmyra Atoll National Wildlife Refuge, northern Line Islands

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Littoral (coastal) sediment cells are compartments comprising shorelines and associated nearshore areas within which the sediment budget is balanced and involves supply, transport along the coast and eventual permanent loss into a sediment sink. Their recognition has proven valuable to coastal zone management in many areas of the world because it emphasises that sediment transport and deposition relate to physical processes rather than to administrative boundaries and that sedimentary units are self-contained. To date, cells identified for shoreline management planning are often extensive, extending for tens to hundreds of km. However, the concept is also applicable to the management of atolls which, although spatially small overall, consist of isolated segments with efficient sediment sinks. Palmyra Atoll, a protected wildlife refuge in the northern Line Islands, is undergoing natural major changes resulting from sediment-related processes. Defining sediment cells as integral parts of management units here will aid the decision-making necessary for the protection of specific areas, potentially giving savings in research effort and remedial costs and minimising disruption to other sensitive areas of the reserve.

COLLEN, GARTON & Others

Geochemical and biological evidence of anthropogenic environmental changes to Palmyra Atoll lagoon, northern Line Islands

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The intense disturbance to the ecosystems and lagoon environments of Palmyra Atoll from military construction between 1940 and 1945 has left a recognisable imprint in the lagoon sedimentary record. Here we report on a piston core recovered from the atoll's West Lagoon that penetrates a sedimentary unit resulting from the military construction and allows us to compare the pre-1940 environments with the present lagoon system. The core chronology is not yet completed and an unknown thickness of sediment beneath the construction layers may have been removed by dredging. However, results from faunal and stable isotope analyses indicate that, before 1940, the lagoon waters were moderately oxic and nutrient-rich, with a varied ecosystem. During the construction years, rapid carbonate sedimentation occurred and nutrient levels were very low. Since 1945, sedimentation rates have gradually slowed, nutrient levels have risen dramatically and there have been fewer larger predators in the ecosystem. Nutrient levels can be related to the abundance of ground-nesting birds. Despite the cutting of a shipping channel across the reef flats to the open ocean in 1940, lagoon waters are now stratified and compartmentalised, with extreme anoxia and hydrogen sulphide values characterising most places below 30 m water depth.

DAMLAMIAN

Tsunami and inundation modelling in the South Pacific

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Tsunami risk reduction involves the understanding of possible impacts to minimise consequences such as the loss of lives, damage of property, business and infrastructure.

SOPAC and Geoscience Australia (GA) have received support from AusAID to assist Pacific Island countries in assessing the tsunami hazard faced by nations in the southwest Pacific. As part of this effort, GA has successfully transferred tsunami and inundation modelling capacity to SOPAC, and recent events such as the 2006 earthquake in the Tonga trench and the tragic 2007 Solomon tsunami are being investigated in detail.

One of the main obstacles to this study to date has been the lack of baseline data to ensure the reliability of the results. The project has made use of some innovative techniques such extracting bathymetry from satellite imagery in order to supplement the available data in the nearshore area. With adequate baseline data, such as high-resolution reef, inter-tidal and topography data, SOPAC will not only be able to provide its member countries with an effective assessment of tsunami inundation impact from trench earthquakes, but also be able to analyse historical and future tsunamigenic landslides and associated inundation impacts.

FINAU & SINCLAIR

Monitoring the effects of mineral water abstraction on Fijian groundwater systems

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The bottled water export industry in Fiji is worth more than USD 50 Million per annum, an estimated 10% of total exports in Fiji. In July 2008 the Fiji government attempted to impose a tax of 20 cents per litre excise duty for domestic and exported bottled waters. In response, the mineral water industry collectively agreed to cease production, with the result that government reversed its decision and the tax issue is now under review.

Whilst the rights and wrongs of taxing the mineral water industry are still being discussed in public forums, what is apparent is that the public debate over the fate of the mineral water industry is being held without comprehension of the relevant and basic the technical facts. Missing from the discussions is a clear understanding of the groundwater system and factual assessments of any impacts abstracting groundwater may have on the groundwater resources and the environment.

The Mineral Resources Department (MRD), who are responsible for groundwater resources in Fiji, are recognising the need for further information on recharge, amounts of water abstracted,

estimations of sustainable yield, and impacts to the environment, as well as the effective communication of this information to key stakeholders and the public.

For the purpose of allowing informed discussion to take place and to ensure the sustainability of the mineral water industry in Fiji, MRD in conjunction with SOPAC are therefore proposing a project which will invite industry and local communities to assist in the investigation of the dynamics of the groundwater system from mineral water abstraction.

The objectives of the project, which is expected to be undertaken over two years, will be to further the understanding of the groundwater system, assess impacts, and assist in the sustainable development of the industry. The approach suggested is a partnership investigation between government and industry with local community involvement. This participatory and collaborative approach aims to foster understanding of the issues at hand and trust between the involved stakeholders, thereby reducing the risk of future conflicts over water allocation.

Outcomes and information resulting from the project will be actively communicated through suitable media to enhance public understanding of the issue at hand. It is also anticipated that the outcomes of the project will make substantial contributions to the ongoing process of establishing overarching water policy and legislation for Fiji, by piloting water resource monitoring as a crucial part of integrated water resources management, specifically in regards to water resources allocation and groundwater protection.

FORSTREUTER

Overlay Analysis in Raster Data Environment for Water Catchment Monitoring, Example Solomon Islands

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Monitoring of water catchments gains importance in many Pacific Island Countries as the quality of water supply is under stress. GIS and remote sensing provide the ideal tool for monitoring and weighting the vulnerability of water catchments in a quantitative way. The key for this is the spatial combination (overlay) of information derived from digital elevation models (DEM) such as slope, aspect and exposition with other sources of information such as land use, soil information, the extend of landslides and population data, which a requires procedure called overlay analysis. This procedure combines the different spatial layers and produces new output layers enabling a quantitative spatial analysis.

Overlay analysis is difficult to perform in vector GIS software (MapInfo) distributed in all island states through the current SOPAC-EU Project. The presentation will demonstrate how this procedure can be carried out utilising ERDAS a raster bas0ed image analysis but also GIS software, which was also distributed through the same project. In addition, the presentation will show the type of information produced e.g. a) areas classified in different risk categories of landslide occurrences or b) sub-catchments weighted due to different flooding risk or c) suitability of water catchments for hydro power generation. However, ERDAS has limits when statistical analysis is required, where Access was utilised to perform the analysis and final map display was transferred to MapInfo. All three products are available in all Pacific Island Countries linked to the SOPAC-EU project and the Solomon Islands multi-disciplinary group was the first user to apply this technique.

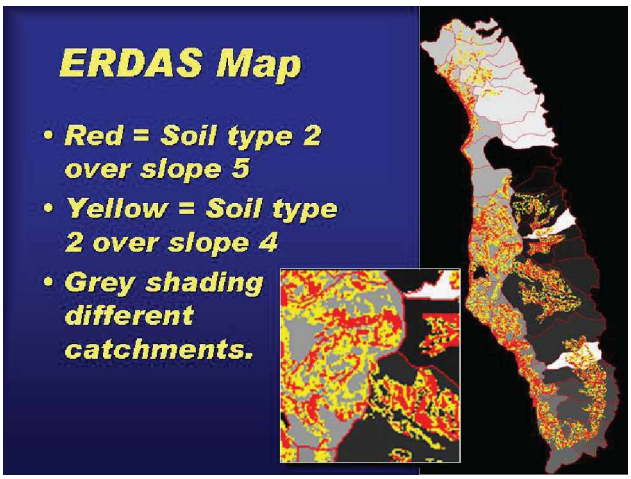

Figure 01: Output of an overly analysis combining a) slope classes, b) soil types and c) catchment boundaries. The output was filtered to eliminate cluster (raster data equivalent to polygons) below a minimum area. Such combination of three layers is not possible in MapInfo.

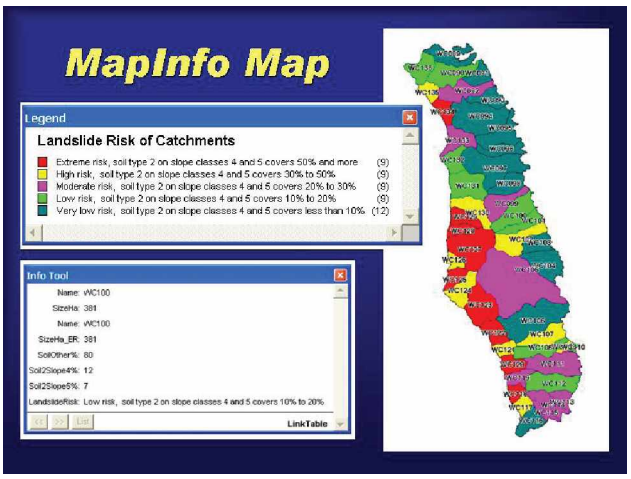

Figure 02: MapInfo was utilised to display the maps, where the information was analysed in Access and created annotation which was linked to the polygon map elements of the catchment boundaries.

Utilisation of TerraSAR-X Image Data for Coastal Mapping

Introduction

TerraSAR-X (see Figure 01) is the first satellite equipped with a highresolution radar system capable of recording with a spatial resolution down to 1m enabling mapping at 1:10,000 scale. SOPAC ordered data from the Nadi area in Viti Levu to map water bodies after cyclone Gene. There is a general interest to also map coastlines applying new type of radar data because the data is cost effective and can be recorded shortly after coastal erosion has taken place, as radar beams penetrate even thick cloud cover, which normally disables optical recording of images during or shortly after cyclones.

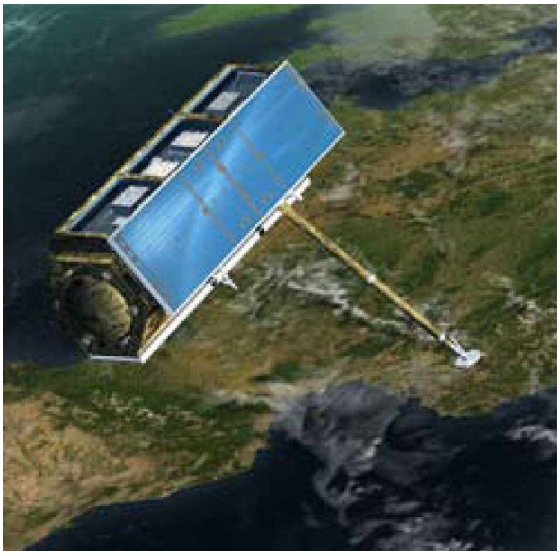

Figure 01: TerraSAR-X.

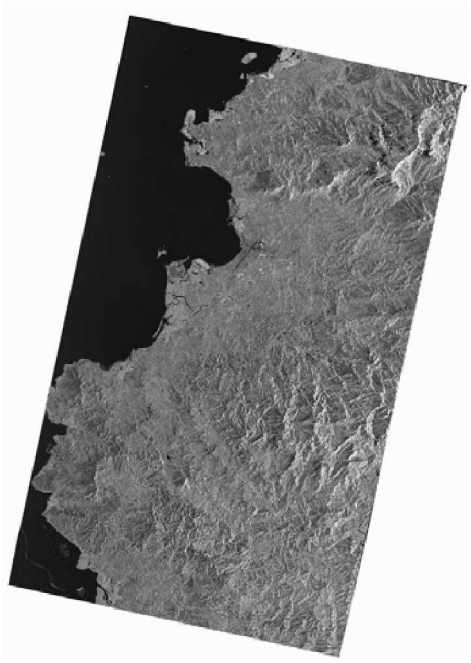

Figure 02: Coverage of the TerraSAR-X radar scene (30 x 60 km).

The TerraSAR-X Image

The Nadi image was recorded on Valentines Day (14.02.08) at 17:48 GMT, which is 05:48 on 15.02.08 Fiji time. The data cost € 1,375 (USD 2,186) and covers an area of 30 x 60 = 1,800 square km (see Figure 02) with 3 m resolution (StripMap), which is equivalent to € 0.8 (USD 1.2) per square km. SOPAC could download the image data 12 hours after recording. In comparison: IKONOS or QuickBird image data would take an average of more than a month to receive the images after the satellite takes the pictures and cost USD 15 to 20 per square km. The TerraSAR-X image data arrived rectified to UTM WGS84. Compared with pan-sharpened QuickBird data, which arrived rectified to the same coordinate system an average difference of 183 m was recorded. Both types of image data has to be re-rectified in the Pacific.

Coastline Mapping

Interpreters normally utilise the colour difference when delineating on QuickBird or IKONOS images between a) vegetation indicating land or b) sand and water indicating the area covered by the sea. The radar sensor is not sensitive to colours; the sensor records the intensity of the beam reflected from the target back into the sensor which is influenced by the angle of the objects surface towards the sensor, the texture and even the type of the material. Water normally has a very low reflection as the beam is reflected away from the sensor and water bodies appear black. The mapping of the coastline is therefore theoretically very clear and mapping with pan-sharpened QuickBird data providing 5 times higher resolution (60 cm) resulted in the same waterline (see Figure 03). However, there are some anomalies in other areas where the radar data based mapping creates a different line between land and sea compared with QuickBird image data based mapping (see Figure 04). The reason is not related to coastal change between 2006 when the QuickBird images were recorded and Valentines Day 2008, it is the difference in tide. On 15 February 2008 at 05:48 it was just one hour before a very low tide (0.7 m below normal low tide). Sand was dry and created a high reflection.

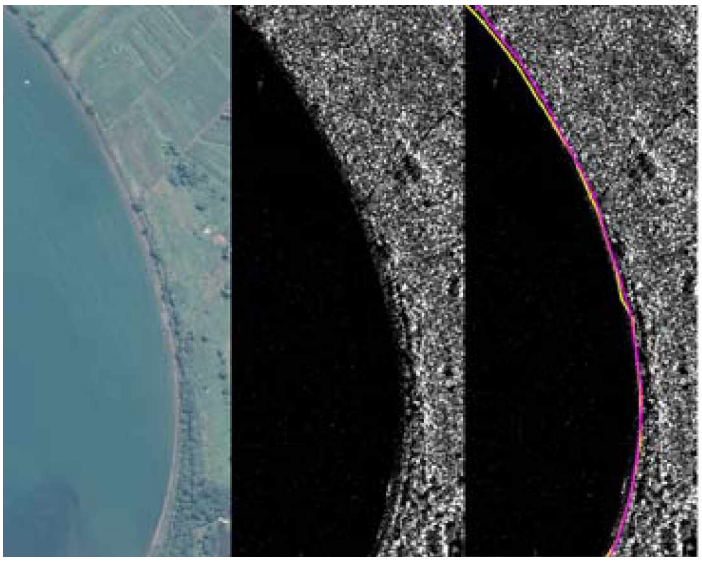

Figure 03: Comparison of coastline mapping using TerraSAR-X data 3 m (black and white) and pan-sharpened QuickBird data 60 cm. If there are no parts which are not covered by water the mapping is accurate within 1:10,000 scale limits.

Conclusions

Radar images of the new generation such as TerraSAR-X and also RadarSat-2 provide a spaceborn image data source enabling coastline mapping at 1:10,000 scale.

Radar data can be recorded shortly after erosion takes place when the area is normally still under thick cloud cover.

For coastal mapping, data has to be recorded during high tide and not during low tide.

Radar data 10 times more cost effective.

Figure 04: During low tide areas not covered by water have a reflection like real land areas and an interpreter is not capable to see that these parts are sandbanks normally covered by water, which is possible with optical image data.

Some reasons that TerraSAR-X data can be delivered much faster than image data of optical sensors, are as follows:

- The radar satellite can record also during night time and therefore has more over flights,
- The radar sensor can penetrate clouds and every programming to record a target area creates images, whereas optical sensors might record clouds and the customer has to wait until a next free onboard storage capacity allows to records the area again.
- The radar data can be received via internet, whereas currently the data of optical sensors are subject to complicated purchase and delivery procedures, which result in several weeks or months between request and receiving the image data.

To be able to geometrically rectify high-resolution radar images, rectified high-resolution image data with sub 5 m resolution has to be available or a network of corner reflectors has to be established. This has to be integrated in the Reference Image Point database, which is currently in the design phase.

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FORSTREUTER & ARCHBOLD

Reference Image Points

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Introduction

Experience show that geo-referenced satellite image data received for Pacific Island Countries are often not correct (see Figure 01) and have be checked and mostly geometrically corrected.

During the discussion on day four of the Regional GIS&RS User Conference the outline of a Reference Image Points (RIP) network was discussed and the need was addressed by several Pacific Island Countries. RIPs are points of know coordinates (X, Y and Z), which are also visible in the image. The setup of existing ground control point networks of several Pacific Land Departments are not usable as these points are not necessarily visible in the image data. It was therefore decided not to speak about Ground Control Points but speak of Reference Image Points.

Characteristics of RIPs

Figure 01: A fence corner as reference image point. 60 cm width is clearly visible in the pan-sharpened QuickBird image. Red the location of position recording, green the corresponding position in the geo-referenced image data.

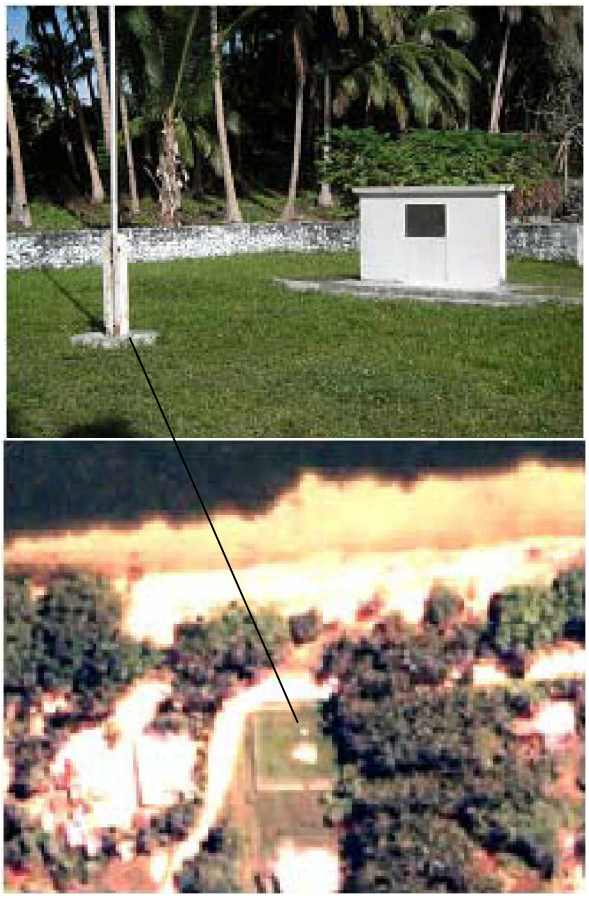

Figure 02: Through the high contrast to the grass around the flag pole foundation of 60-cm diameter is clearly visible in the image data (pan-sharpened QuickBird). The centre of the foundation can be recorded as reference image point.

To ensure that RIPs are visible in the image data features have to be selected, which have contrast against the background. At the same time the RIPs must have the required accuracy for the corresponding image scale. For example pan-sharpened QuickBird images have a resolution of 60 cm and the RIPs therefore must be located with decimetre accuracy. In semi urban areas corners of fences provide good references, as linear elements such as fences are mostly visible far below the image resolution. The 20 cm concrete foundation of the fence in Figure 01 is clearly visible and the corner point can be exactly located on the image. Sometimes point features provide a strong contrast against the background such as the base of the flagpole in Figure 02. In urban areas roof corners can be utilised if a GPS survey is possible in such areas.

So far, the situation in rural areas and especially in forested areas has to be explored, as there are no experience in the Pacific yet. Possibly permanent marker have to be established.

Survey of RIPs

Like the features of RIPs also the survey has to follow the requirements of the image scale; this refers to the field data collection and the post survey treatment.

Field Survey

1:10,000 scale (multi-spectral IKONOS image data) requires 2 to 3 m accurate RIPs are and a GPS enabling differential correction is sufficient for the work. 1:5,000 scale (pan-sharpened QuickBird image data) requires a totally different GPS setup, survey grade GPS receivers are necessary which can analyse the carrier phase and provide position data in centimetre accuracy. For the survey the base station has to have a location in cm accuracy. This can be achieved by either selecting and existing ground control point and get the coordinates (X, Y, Z) from the corresponding Land and Survey Department or by establishing an own Absolute Reference Point (ARP) as shown in Figure 03.

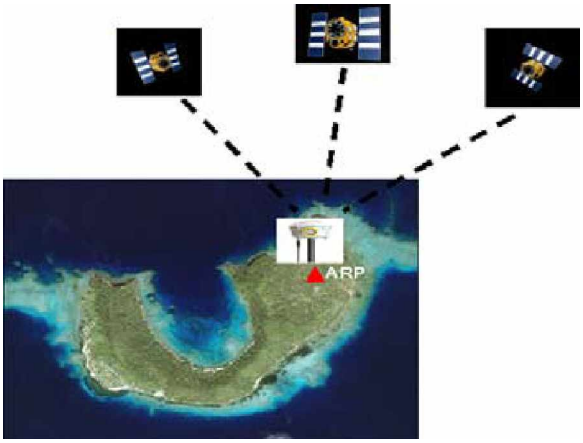

Figure 03: Survey grade receivers and 24 hour recording in static mode is necessary to record Absolute Reference Points.

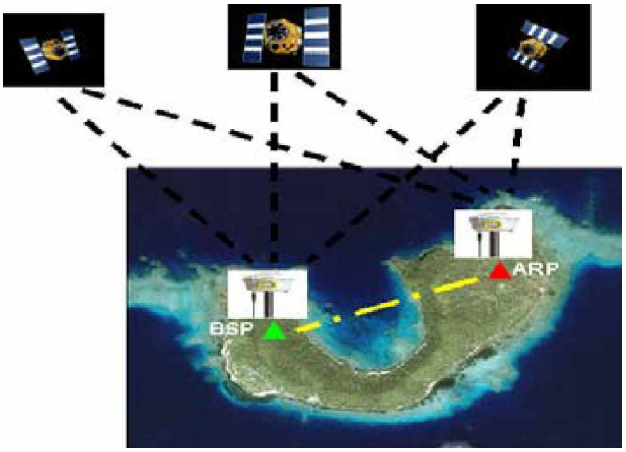

Figure 04: To establish Base Station Points (BSP) one GPS receiver has to be positioned at the BSP and one at the ARP and both receivers have to record for one hour in static mode. This allows the base line calculation by the GPS software.

To establish a ARP the receiver has to record for 24 hours in static mode, Then Base Station Points (BSP) have to be established where both a) the base station receiver and b) the rover unit record simultaneously for 1 hour in static mode (see Figure 04). Having done this, the base station can be established at the BSP and the RIPs can be surveyed in a circle around the base station of maximum 15 km. On each RIP the GPS receiver has to record for 0.5 hour (see Figure 05).

Post Field Survey Correction

After finishing the survey of RIPs the user has to download data from the two closest South Pacific regional GPS base stations. The data is available on Australia's GeoScience website: www.ga.gov.au/geodesy/slm/spslcmp/network.jsp Having the data the position of the ARP has to be adjusted using for exemple Trimble Geomatics Office software. The BSPs and RIPs have to be adjusted as well.

Database

During the discussion as part of the Regional GIS&RS User Conference it was also stated that there should be a RIP database, which can be accessed by everybody including the satellite data

distributing companies. This is currently on the way, Franck Magron at SPC Noumea is establishing it. This database will keep for every RIP:

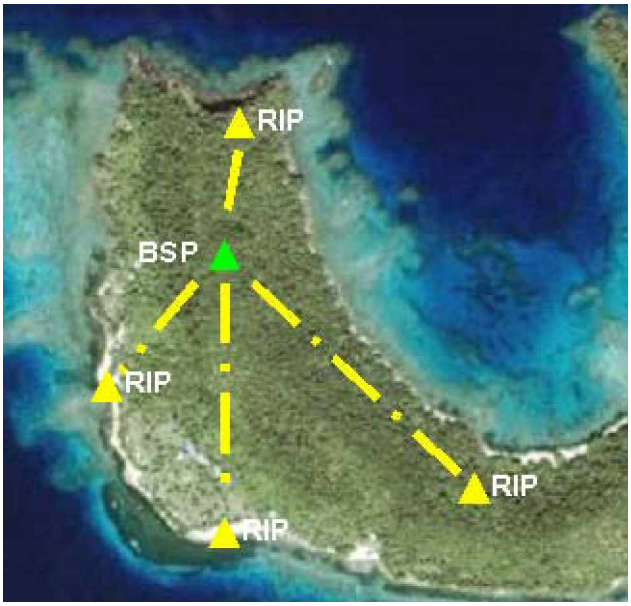

Figure 05: After the BSP is established the Reference Image Points can be surveyed in an radius of maximal 15 km around the base station.

1) A small subset of the image data, where the RIP is visible.
2) The position data and survey details e.g. base station was utilised, correction by AUSLIG, etc.
3) A photo of the feature in the field.
4) A description of the feature and the features location.

The database will be on www.picisoc.org website.

Summary and Recommendations

To utilise image data as backdrops with correct image geo-reference a RIP database is essential. If all users who produce image backdrops work together funds and effort can be saved. Solutions have to be found to establish RIPs in areas covered by vegetation or on reefs. New solutions might be also necessary to include RIPs for radar data.

FORSTREUTER & PAPAO

Digital Elevation Model of Beaches Using RTK GPS

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Introduction

SOPAC purchased RTK GPS equipment (FJD 160,000), which allows position data collection providing an accuracy sufficient to produce 20 cm contour lines ideal for mapping low lying areas.

Purpose of Beach DEM

Sand or beach movements on atoll islands have the potential to cause significant problems for housing and infrastructure. It is important to monitor where the sand drifts away and where beach is building up. The reasons for these shoreline movements are still not fully known. However, understanding it would allow one to take certain precautions to reduce negative impact.

Contour lines of sub-metre accuracy are required to map the shape of the beach and the DEM will then provide the basis for any monitoring. A re-survey after one or two years or directly after the visible impact of a storm can be used to compare both DEMs in a quantitative way and a figure of cubic metre sand washed away or accreted can be provided using available software.

The purpose of this particular DEM in Laura at the end of the Majuro lagoon was to test equipment and software under real conditions. Therefore the situation was simulated where islands and atolls often have no survey points. This requires a base station to be established as an absolute reference point.

Technical Steps of Survey and DEM Establishment

Setup of Base Station (Absolute Reference Point)

A base station provides fixed point towards all other points of a survey are referenced. To setup a new reference point a base station has to run 24 hours without interruption to average the position calculated. This set of position data is then referenced to other base stations in the Pacific region to further increase the accuracy of the position. This is handled by AUSPOS Online GPS Processing.

In the beginning the team tried to establish such an absolute reference point of the roof on the EPA office, however, the system did not work properly. Then a location on the roof of the high school in Laura was proven to be safe enough to keep the base station running 24 hours without interruption.

Survey and Data Correction

For the DEM a grid of 4 m intervals was surveyed where the surveyor is guided by a little map to the next survey point. There he initialises the data receiving and gets an acoustical signal after sufficient position receiving and moves to the next survey point. After the end of survey the data has to be downloaded from the rover or control unit and imported into Trimble Business Centre. During the import antenna height and other survey details can be corrected. From the Trimble software the file can be exported as ASCII format. during a RTK survey the rover positions are corrected each time it receives a signal from the base station.

The DEM Establishment

The ASCII files were then imported to Access for data editing, which will be explained in the next chapter. From Access the data sets were exported again to ASCII (txt). The files required a renaming to dat extension before ERDAS allowed an import. The ERDAS import was handled by the surfer module, which at the same time converts the X, Y and Z values into a DEM.

Figure 01: Local base station established on a engine block at the beach. The GPS antenna is mounted on a pole to increase the height and subsequently the field of view.

Problems Faced and Solutions Developed

Base Station Recording

The base station was equipped with an internal battery and a car battery which was supposed to take over after the internal battery runs out. This did not work the base station simply switched off after the internal battery was exhausted, however, it worked when the internal battery was removed and the base station was connected to the car battery right from the beginning.

Vegetation and Radio Signal

Under ideal conditions a rover is able to ceceive base station corrections up to 40 km, however, where vegetation is obstructing line of sight even with a distance of 3.5 km the rover could not receive the base station signal. this is the case when surveying close to the vegetation line.

The solution was to setup a second base station in suitable distance to the vegetation line providing the line of sight to the rover units. Every day this local base station was established at the exact same position. The averaged local base station height was used to adjust the surveyed beach position data.

To decrease the influence of obstructions the local base station was mounted on a pole, see Figure 01.

Survey of Reef Flat

The reef flat was included in the survey, which did not produce expected results related to:

a) The point distance: At a level of 20 cm contour line interval the grid distance of 4-5 m is too big approximately a 1 m grid would improve the result. With a 4-5 m grid and a pixel size of 1 x 1 m local unevenness is overrepresented.

b) Bigger size holes in the reef flat cannot be surveyed without risking expensive equipment. These important parts of the reef flat are underrepresented in the DEM.

c) The low water mark, where the waves are breaking on the reef could not be surveyed correctly as it was too dangerous for the equipment even at low tide. GPS equipment is not suitable for surveying the low water mark line the horizontal position can be extracted from satellite images and the vertical position is known.

Figure 02: The erosion line. During extreme tides the water washes the sand away and the tree roots are free. This line moves inland and is an important indicator of the erosion status. At this location it forms a step of about 1m height.

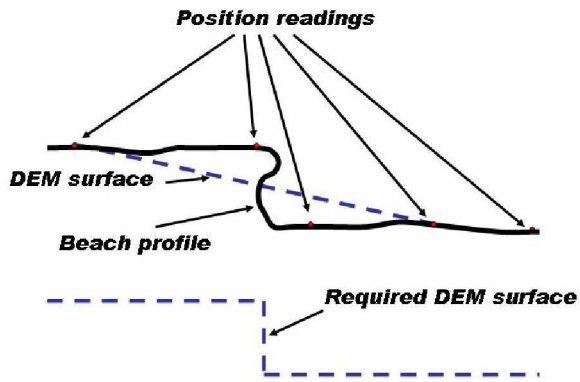

Figure 03: The DEM was established with ERDAS and this software with does not provide a module creating break lines. The DEM surface is equalising the erosion line as position readings of the second line are acting with each other.

The Erosion Line

The erosion line is break line created during highest water and strong wind. It indicates the frontline of the beach erosion see Figure 02. It was possible to survey most of the line due to adjustment of the equipment, see chapter Vegetation Cover. However, creating the DEM with ERDAS software this break line disappears, as the ERDAS module surface levels it out. Here software is required, which has an inbuilt break line function. ERDAS is providing this now as add on module to ArcGIS but not within its ERDAS Imagine modules. Trimble Business Centre has a breake line function, however, the product is far too expensive to be distributed in addition to ERDAS.

Vegetation Cover

RTK GPS is sensitive to vegetation cover making it difficult to survey the erosion line. It helped to mount the rover on two joined poles increasing the height above ground from 2 m to 4 m. It was possible to map most of the erosion line without loosing the satellite signals. In cases with very thick vegetation cover (see Figure 04) the increase did not help. In this case the DEM was edited as follows: a) In MapInfo environ ment points were created along the position of the erosion line, which provides the X and Y values, b) In Access the Z value of these points was added from points with recoded height nearby, c) These points were added to the GPS readings and the DEM was re-created showing a more realistic situation (see Figure 08).

Figure 04: At this beach location the erosion line was under thick tree cover. GPS reading was impossible.

Multi Path in Vegetation

While surveying the erosion on one location (see Figure 7 arrow A) the GPS received positions with Z values 3 m higher than the surrounding values. The real reason is still unknown and assumed as effect of multi path. These obviously wrong values were manually edited in Access and the DTM re-created without these anomalies.

Figure 05: Mounting the rover on a 4 m pole allowed GPS receiving under thin vegetation cover.

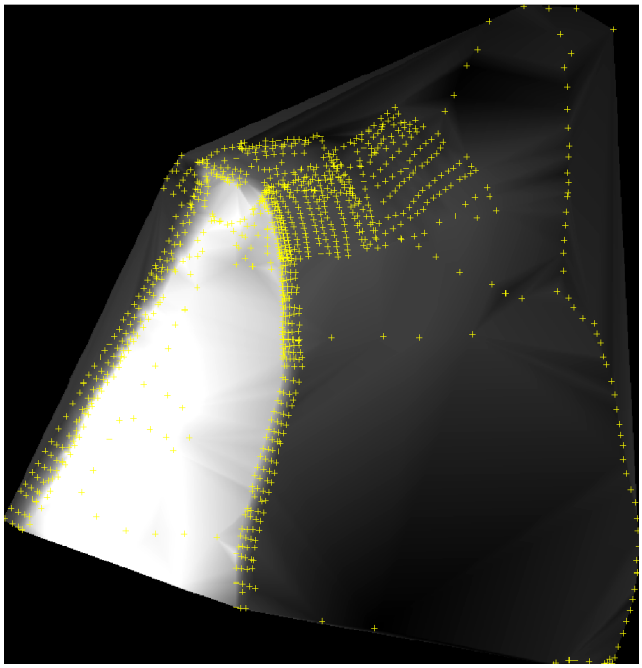

Figure 06: The DEM display in ERDAS Imagine software imported to MapInfo and overlaid with position data.

Outline of DEM

In cases where the DEM does not have a round shape the Surfer module of ERDAS fills these gaps with height values interpolated between the outline height values. This is visible in Figure 7, where the arrows (C) indicate the recorded positions and the surfer module creates a slope towards the outline. There are two ways to avoid this:

a) The DEM can be clipped along the outline of recorded positon data using ERDAS modules.

b) Postion points (indicated with arrow C in Figure 7) can be shifted to the outside line and the slope disappears (see Figure 8).

Summary and Recommendations

The RTK GPS equipment was purchased to have a tool for creating beach DEMs. The system fulfils the requirements: “a DEM with 20 cm contour line can be created”.

The idea was to establish successively DEMs for all low lying islands and do re-survey wherever erosion or accretion is visible. This is only feasible if responsible staff from the countries carry out the data collection. The test survey showed that:

- The setup and method still needs development.
- The DEM creation should be carried out directly after the survey in country allowing a re-survey for areas where data is not properly captured.

- Survey and DEM establishment including data cleaning and DEM editing require detailed knowledge about system and data handling.
- The system itself is not as proven as expected.

Currently the system is used for other duties than beach DEM establishment. SOPAC staff should further develop the method allowing it to be used by others. Then a team of technical SOPAC staff should staff should be setup doing the survey together with staff from the Pacific Island Countries.

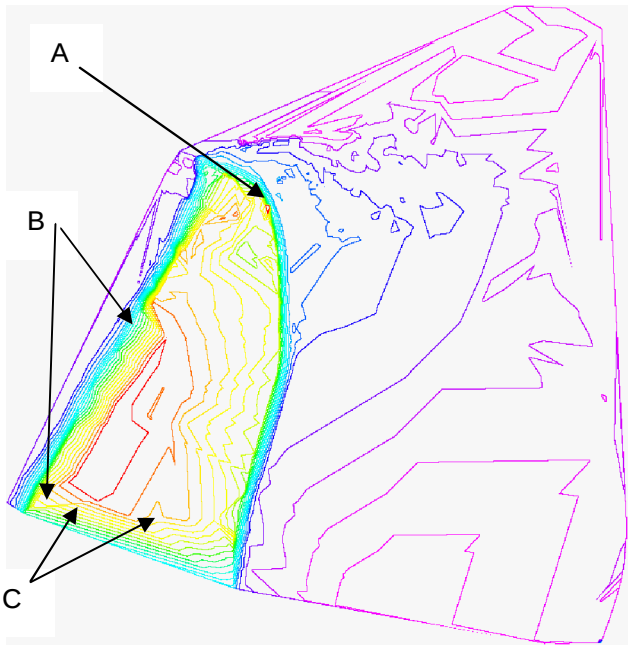

Figure 07: 20 cm contour lines created from the DEM. A = wrong height receivings, B = missing points due to thick vegetation cover, C = position points which should be recorded on the outside line.

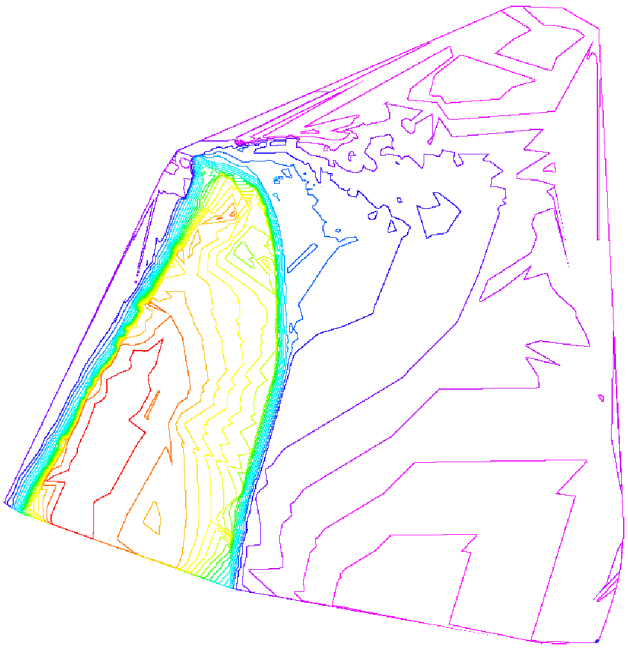

Figure 08: 20 cm contour lines created from the DEM after height and position correction.

GARDNER & Others (Poster)

Centre for Marine Environmental & Economic Research - Victoria University of Wellington, New Zealand"

Jonathan Gardner[1], John Collen[1], Dave Garton[2], James Bell[1], Simon Davy[1] & Ken Ryan[1]
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Victoria University's Centre for Marine Environmental & Economic Research (CMEER) is a multi-disciplinary research centre which integrates expertise and experience in all areas of marine research. CMEER's functions are to promote and enhance collaborative marine research, to develop new working relationships with indigenous peoples in the Pacific region, and to provide independent and expert advice on all matters of marine research, including science, economics, public policy and law. In this poster presentation, CMEER's work is illustrated using examples of our research.

GREENE

The influence of freshwater on the marine system – impacts at the terrestrial-marine interface and lessons Learned in San Juan Archipelago and application to the SOPAC Region

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One of the greatest impacts upon the nearshore marine system is the introduction of particulate and chemical contaminants by rivers, streams and other terrestrial point and non-point sources such as aquifer leakage. Estuaries, bays, lagoons, and sounds, especially those poorly flushed, are particular prone to contaminant accumulation. These are depot centers for both contaminants and sediment and the impact upon their ecosystem is directly related to the cumulative effect of the downstream or down-aquifer transport and concentration of contaminants. Although declining ecosystems indicate where the impacts of the freshwater transported contaminants may be taking place, it is difficult to pinpoint specific sources and to evaluate the impacts because of the lack of good baseline data sets. In the San Juan Archipelago freshwater input into the dynamic tidal swept Salish Sea of the Canadian Georgia Basin and American Puget Sound regions has introduced contaminants that have been trapped in relative quiet water bays and sounds. Historically, the introduction of the contaminants is relatively young, occurring only within the past 150 years when industrialization of the region was initiated along the rivers, streams and coastline of the Salish Sea. Today indicators such as declining eelgrass beds, reduction of salmon, rockfish, and marine mammals, and increased algae blooms all point to the cumulative effect of fresh water transported pollutants. These pollutants originate from the past and present operations of logging, pulp and lumber mills, refineries, shipbuilding and other industrial activities as well as from residential contributions such as poorly operating septic systems. However, recent realization of contaminant concentrations and their affect upon the ecosystem has brought about the support of industry and residences alike to clean up their acts. The realization that no matter how small a freshwater spring, creek or stream is, what ever it carries is cumulative downstream and it eventually influences the marine system and thus has the potential for worldly impacts. Lessons being learned in the San Juan Islands region have direct application to both those volcanic islands and atolls of the south Pacific, especially those islands that are fringed with reefs and dominated by lagoons.

HETUTU & HASAN (Poster)

Water Quality Monitoring – Niue

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The poster paper highlights water quality monitoring in Niue. It outlines briefly the agency responsible for performing water quality monitoring and the parameters tested in the laboratory.

The poster also displays the microbial quality of the drinking water being supplied in Niue. The E.coli results for the first quarter of 2008 are tabulated alongside a map of Niue which identifies the location of the sampling area.

The nature of the support provided by SOPAC and WHO under the regional NZAID-funded Water Quality Monitoring Programme towards assisting Niue with building their capacity for monitoring is also mentioned.

KRUGER & DAMLAMIAN

Hydro-environmental survey and modelling of an enclosed lagoon, Aitutaki, Cook Islands

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The potential for further economic growth on Aitutaki is in part constrained by the limited port handling capabilities and the cost associated with the unloading of containers. Vessels currently have to remain offshore outside of Arutanga Port, while goods are unloaded and transported by barge through the narrow entrance channel. Depending on tides and weather conditions this expensive and time-consuming process can take from one to three days to complete. Plans to deepen and widen the entrance channel could help to lower shipping costs and boost the number of visiting tourist yachts. A survey to collect oceanographic data such as waves, current velocities, water levels, and bathymetry was conducted in order to provide baseline information for a water circulation model of Aitutaki. Preliminary results indicate that the current velocities in the lagoon are primarily driven by open-ocean wave conditions. The work to develop a computer-based hydrodynamic model will help to fill information gaps in our understanding of Aitutaki's lagoon.

This project highlights the importance that development plans such as the proposed capital dredging in Aitutaki is given careful consideration and evaluation as it may have significant impacts on the water circulation and sediment transport patterns in the vicinity of the channel. Other lagoon-wide effects such as changes in water level could influence the health of beaches and the marine ecosystem – both staples of the tourism industry. The capital dredging may also lead to accelerated sediment accumulation in the deepened channel, an undesirable consequence that will require frequent and costly maintenance dredging.

KRUGER & Others

Shallow water marine habitat mapping, Aitutaki, Cook Islands

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The potential for further economic growth on Aitutaki is in part constrained by the limited port handling capabilities and the cost associated with the unloading of containers. Vessels currently have to remain offshore outside of Arutanga Port , while goods are unloaded and transported by barge through the narrow entrance channel. Depending on tides and weather conditions this expensive and time-consuming process can take from one to three days to complete. Plans to deepen and widen the entrance channel could help to lower shipping costs and boost the number of visiting tourist yachts. Benthic transects in selected locations were used to provide detailed information about the various habitats in the marine ecosystem. The final habitat map was created by combining classified geocoded underwater photos with the detailed analysis of high

resolution satellite imagery. The work to develop a detailed habitat map for the entire Aitutaki Lagoon provides important baseline information that will help to develop effective engineering solutions for any proposed project to expand the entrance channel. These new management tools could also help the Aitutaki community to select new Marine Protected Areas or identify potential sites to develop aquaculture initiatives

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LENISTON

Building partnerships for water and sanitation – the WASH coalition

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The International Year of Sanitation 2008 creates an excellent opportunity to strengthen collaboration between a wide range of regional and international agencies to improve delivery of water supply, sanitation and hygiene activities.

Increasing interest in water and sanitation support provided to the region by donors and other organisations has resulted in a large number of overlapping interventions and it has become increasingly important to ensure that work carried out on this area is well coordinated in order to avoid duplication.

The Pacific WASH Coalition is utilising existing partnerships, such as established under the Pacific Partnership Initiative on Sustainable Water Management, to build on ongoing work programmes and activities in Pacific Island countries.

Partners in the WASH Coalition coordinated by SOPAC include the Foundation of the Peoples of the South Pacific International (FSPI), the Fiji School of Medicine (FSchM), Live and Learn Environmental Education (LLEE), the World Health Organization (WHO), the United Nations Children's Fund (UNICEF) and the International Federation of Red Cross (IFRC).

LOTOLUA

40 kW Grid-Connected Solar PV System in Tuvalu

Mafalu Lotolua
General Manager, Tuvalu Electricity Corporation, Funafuti, Tuvalu

40 kW grid-connected solar PV system in Funafuti

The Tuvalu Electricity Corporation (TEC) is responsible for electricity supply to all the 8 islands in the Tuvalu group. There are about 1570 households with nearly 6 persons per household in Tuvalu. Funafuti with 4492 people has more than 48% of the total population. Vaitupu with 1591 is a distant second and the other islands range from 400-700 people except for tiny Niulakita with only 35 residents. TEC's generation capacity presently consists of a brand new 1.8 MW diesel

plant at Funafuti and a total of 1.2 MW in the outer islands. TEC also manages a number of solar PV home systems on the island of Niulakita.

TEC has recently received assistance from the e8-Group[1] for the installation of a 40 kW grid-connected solar PV system in Funafuti. The project cost US$412,000 and meets 5% of the peak demand in Funafuti with an estimated output of 56 MWh per year. The project was commissioned in February 2008 and as of May, has resulted in savings of 625 litres of diesel equivalent to avoided emissions of 1.91 tonnes of CO_2.

The presentation will focus on the technical design including an update of actual system performance and some of the challenges and concerns of such technologies in small Pacific island countries.

MOLIPI & CRENNAN

Ecosanitation in Tuvalu - one solution to many problems

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Tuvalu is primarily dependent on rainwater and in times of drought households rely on water delivery from national reserves and ultimately on desalination. Groundwater, which used to be a secondary source of water, is now too polluted to use on Funafuti and is rapidly becoming increasingly polluted on outer islands. The main reason for this can be traced back to increased population pressure combined with inadequate treatment of animal, human and chemical waste.

Recent audits shows that an estimated 96% of septic systems on Funafuti are not properly constructed, causing discharges directly into the groundwater and surrounding coastal waters, threatening human health and contributing to the complete destruction of coral reefs up to 200 m offshore in the lagoon.

Funafuti is a low lying atoll with a high water table, causing wastewater to come to the surface during extreme high tides, threatening the health of children who often play in the pools of water and wet soil. Furthermore, the unsustainable use of precious water resources to flush toilets increases vulnerability to prolonged droughts, which can be expected to increase in response to climate change.

A recent study on the economics of liquid waste management in Funafuti showed that poor sanitation is costing the nation an estimate of AUD 500,000 per year (P. Lal, K. Saloa & F. Willy, 2006) in impacts on human health, the preventative costs incurred by individuals and government in the use of alternative water (including rainwater tanks, bottled water and desalinated water), as well as limited costs to the coastal fisheries.

Ecosanitation has been introduced in Tuvalu as a cost-effective and sustainable alternative in response to these problems. Composting toilets, as part of this holistic approach have been successfully trialled in several sites over a number of years. The compost toilets have been highly appreciated by the families that have had been involved in the trials, this positive experience now needs to be extended to the wider community. Bio-digesters are also being trialled for treatment

[1] An association of major Power Utilities from Canada, France, Germany, Italy, Japan, Russia and the United States

of pig waste. These pilots have built a resident capacity in Tuvalu for the construction and maintenance of Ecosanitation installations.

As Tuvalu moves towards an integrated approach to water resources management, Ecosanitation provides a potent example of how one solution can respond to many problems. Wastewater management using an Ecosanitation approach has therefore been put forward as the selected priority to be addressed through a national demonstration of integrated water resource management which will be supported by the Global Environment Facility (GEF) through SOPAC in 2008-2013.

MURATA & UCHIDA (Paper & Poster)

Hydrographic Observations Along 17°S Line in the South Pacific: Re-occupation of WHP P21 Section

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Introduction

The ocean regulates regional and global climate by exchanging heat and materials with the atmosphere, and by circulating them in the interior of the ocean. Thus it is an urgent task to estimate accurately how much heat and anthropogenic CO_2 are absorbed in the ocean, because these properties are crucial in determining the magnitude of global warming in future. For the accurate estimation, high-accurate data have to be collected repeatedly at an interval of a decade at least. Now we have a plan to conduct hydrographic observations along 17°S line in the South Pacific, where high-accurate data were obtained in 1995 by a World Ocean Circulation Experiment (WOCE) Hydrographic Programme (WHP) cruise. We will conduct the re-occupation cruise under the framework of Climate Variability and Predictability (CLIVAR)/CO_2 program.

Shipboard observation

The WHP P21 line along nominal 17°S in the South Pacific is shown in Figure 1.

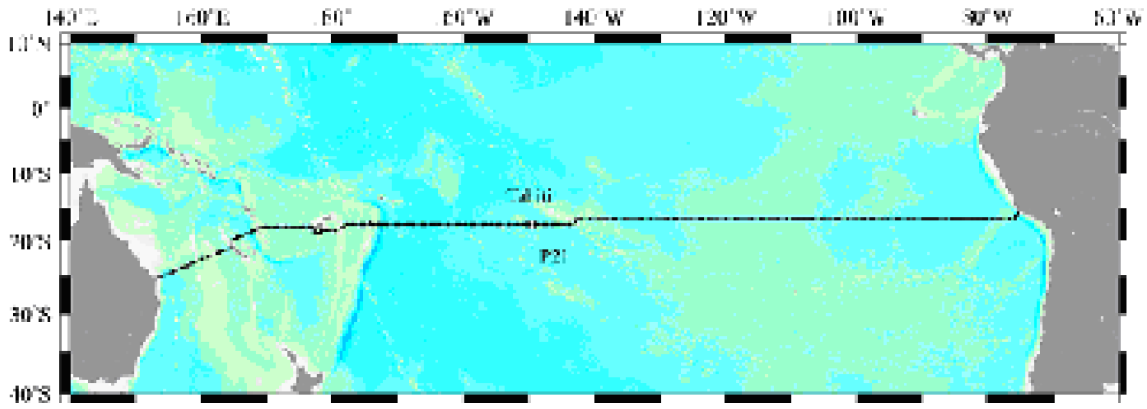

Figure 1. WHP P21 line in the South Pacific.

Along the observation line, we measure continuously physical and chemical properties at the sea surface, using the R/V Mirai belonging to JAMSTEC. At given 272 stations along the observation line, we perform Conductivity-Temperature-Depth (CTD) hydrographic observations. At each

station, water samples at different depths (36 at maximum) from the sea surface to the bottom are also collected with 12L Niskin bottles. The water samples are used on board the Mirai to measure chemical properties. In addition to shipboard analyses, water samples are sent to laboratories on land for further analyses.

Scientific importance of the observation

We have repeated the same type of observation as stated here over the past 5 years, not only in the Pacific Ocean but also in the Atlantic and Indian Oceans. From the obtained data, we found warming along the pathway of Circumpolar Deep Water in the Pacific Ocean. In addition, we detected increases of anthropogenic CO_2 in the upper ocean. These results indicate that data from the oceans in the Southern Hemisphere are important in assessing impacts of global and regional climate changes on the ocean. However, the data are sparse in the observation area. Therefore, collecting data in the region contributes to the assessment.

Scientific products

We measure physical and chemical properties such as: water temperature, salinity, dissolved oxygen, nutrients, CO_2-system properties (pCO_2, total dissolved inorganic carbon, total alkalinity, and pH), chlorofluorocarbons, ^{14}C and ^{13}C. These data are used to estimate more accurate estimation of heat and anthropogenic CO_2 storage in the ocean. The data collected in the cruise are open to public within a few years for further usage.

PANAPA

Integrated Water Resources Management in Tuvalu

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During the last decade, Tuvalu has been moving slowly but steadily towards an integrated approach to water resources management for addressing highly connected and urgent water issues including lack of wastewater treatment, contamination groundwater and coastal waters, drought vulnerability, increasing water demands and inefficient water use.

For this purpose and in response to a particularly severe drought, the Tuvalu Water and Sanitation Committee was established in 2001 to gather representatives from different government departments, the Kaupule and the Tuvalu Association for NGOs to plan strategically and improve coordination of water resources management in Tuvalu.

The Committee has played a central part in taking the first steps towards drafting strategy documents supporting water reform towards integrated management, including a draft National Integrated Water Resources Management (IWRM) Plan and a draft Building Code with provisions for water catchment and wastewater treatment. Due to lack of formal endorsement, clear terms of reference and budget allocation, the Committee has largely been dependent on external support. This has meant that the process to move IWRM forward has been on hold since 2005.

The Tuvalu Water and Sanitation Committee, under the chairmanship of the Ministry of Public Utilities and Industries and supported by the SOPAC-EU IWRM National Planning Programme, is now reigniting the IWRM process and has agreed on key steps to advance an integrated approach to water resources management in Tuvalu.

One of the central priority actions for the Committee will be to review the existing draft IWRM Plan and move it forwards towards adoption by Cabinet. Another priority will be to strengthen the Water and Sanitation Committee to ensure long-term national strategic planning and coordination to respond to key concerns related to water resources management. The IWRM process will give overall strategic guidance for water management in Tuvalu and will involve processes such as drafting water policy, reviewing current legislation in accordance with water management needs, and improving the coordination of the responsibilities of different government department in relation to water resources management.

PETTERSON, CRONIN & Others

Engaging Pacific communities in the environmental change debate: lessons from multi-stakeholder participation exercises and geohazards in Solomon Islands

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Perhaps the most fundamental issue to address with respect to the impacts of environmental change is to recognise that coping mechanisms for it can be found in the strategies that communities have already developed to adapt to a range of environments. Helping people adjust to change can be done in terms of contexturalising their behaviour and response to critical events with the same strategies that are used to cope with daily or yearly events of low magnitude/impact (such as crop failures, droughts, storms, high tides, floods etc). Adapting to creeping environmental change also requires engagement with communities to develop a joint understanding of what these changes may mean for them (e.g. increasing flood events or increasing drought) and thus helping them prepare for a range of potential scenarios. A strong part of this is to use community wisdom that exists from adapting to face past challenges. The key predictions of global climate change for the Pacific include: rising ocean temperatures that raise sea levels and become an even more powerful heat store, with consequent impacts on ocean circulation, ocean-atmosphere interactions, marine ecosystem disturbance and increasing frequency of extreme weather events such as droughts, heavy rain, cyclones, storm surges, high winds etc. These events affect both the low and high islands of the Pacific in different ways.

Pacific islands are no stranger to hazard and risk. Cyclones have been a fact of life throughout Pacific Island history as have geohazards such as earthquakes, volcanic eruptions and tsunamis. Lessons can be learned from previous efforts at sensitising local populations and communities to potential geohazard threat and risk. There are many parallels with living with geohazard risk and events that may occur as a consequence of climate change. Both kinds of events can have a major, if not fatal impact, on human society, its livelihood and quality of life. These events can affect water supplies, agricultural land, livestock and gardens, and important rural and urban infrastructure (such as hospitals and clinics, shops and food stores, roads and bush tracks, communication lines, housing, the local and national economy etc.).

In Solomon Islands the government has faced the challenge of preparing and engaging communities with respect to geohazard risk for decades. Disaster councils at a national and local level together with geoscientists within Government have regularly engaged and interacted with affected communities. Key objectives of engagement events include: the inclusion of as many

stakeholders as possible within the social customs of local communities; to raise awareness and educate; to communicate realistic and evidence-related risks and hazards; to encourage community-led and community-participation approaches; to harvest community wisdom and data with the purpose of identifying important vulnerable elements, precursor warning signals, and possible mitigation strategies and recommendations to feed into holistic disaster plans.

Examples will be drawn from volcanic hazard related engagement events on Savo and Simbo as well as the recent western Solomons tsunami event.

PETTERSON, TOLIA & Others

Geoscience into environmental change policy: the challenge for integrated skills application across a large dispersed geographical area and a limited human resources pool in the Pacific

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At first sight it may seem that geology has little to do with the here and now of climate-induced environmental change. From the policy and decision makers perspective (and even the perspective of other scientists) geology deals with rocks and things of the distant past.

As applied geoscientists we have a duty to our science and our community to ensure that such perceptions are shown to be false by demonstrating the practical and beneficial impact of geoscientific knowledge, methodologies and approaches with respect to environmental change policy within Pacific Island State Governments. Geoscience has so much to contribute to the environmental change debate. Examples include: palaeo- and modern- climate records in corals, reefs and reef sediments; scenario-modelling of groundwater resources and aquifers; catchment modelling; landscape evolution; lifecycle modelling, carbon footprints and supply and demand issues related to natural resources; increased landslide and ground instability conditions; earth systems interaction modelling (e.g. between ocean currents, storm surges, reefs and shorelines, and tectonic uplift and subsidence and the shoreline); coastal erosion modelling and monitoring; the identification of environmental 'tipping points' etc.

The challenge for Pacific geoscientists and their partners and friends around the world is to interact and engage with decision makers in such a way that convinces government that the geoscientific fraternity can help identify and define key problems and issues and assist with developing solutions strategies.

This challenge is difficult enough in a land-locked, highly educated, highly-populated country but is orders of magnitude more difficult in highly dispersed, low density population regions that typify Pacific small island states. Pacific geoscientists are a precious high-value regional resource that must be carefully utilised. However, in many instances, a critical mass of skills is not present in the same place at the same time.

Of course, geoscientists alone cannot solve these complex issues and problems: their skills must combine with other scientists, social scientists, economists, planners and policy makers, etc. in a way that allows the whole community to advance. The Pacific approach to skills management

must involve smart strategies that: 1) identify the key challenge areas that environmental change is throwing up for decision makers in the Pacific; 2) assesses how these impact on decision makers and identifies the knowledge, skills and analytical methodologies required for policy development; 3) generates an inventory of appropriate skills currently present in the Pacific; 4) forecasts people and skills demand and supply models; 5) identifies demand and supply gaps; 6) delivers plans to close the gaps – and in the Pacific example develops solutions that link scarce, precious human skills across thousands of miles of ocean.

This paper will discuss a range of models and approaches for consideration with the aim of encouraging dialogue and debate and moving this issue forwards.

RAMSAY, STEPHENS & Others

Climate change effects on sea levels, waves, run-up and overtopping in Kiribati

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Kiribati is one of the most vulnerable countries in the world to the effects of climate change and sea level rise. Most land on Tarawa, and most other islands in the country, is less than 3 m above sea level. Whilst the islands lie outside the main cyclone paths, coastal flooding due to storms is a periodic occurrence, particularly during La Niña years. With a high population concentration, particularly in Tarawa, increasing coastal development, shoreline erosion and increasing environmental degradation, Kiribati is becoming increasing vulnerable to the effects of climate variability and change. It is estimated that by 2050 economic damage due to climate change and sea-level rise could be the equivalent of 17-34% of Kiribati's 1998 GDP if no adaptation measures are undertaken.

The Kiribati Adaptation Programme (KAP) is being undertaken by the Government of Kiribati to reduce the country's vulnerability to climate variability, change and sea-level rise. The project is now in its second phase, with the objective to implement adaptation measures, and consolidate the mainstreaming of adaptation into national economic policy.

The objective of this particular component of the KAP is to develop climate risk information to be adopted as national standards for options analysis and technical design work ("climate proofing parameters"), particularly regarding coastal and water related issues. For the coastal components, assessments were made of extreme wave conditions around each of the Kiribati Islands, extreme water levels and how they vary within Tarawa lagoon, and how extreme wave conditions and water levels are correlated within the lagoon. A spreadsheet tool was developed to allow assessments to be made of the effect that climate change and sea-level rise would have on site specific nearshore processes, including wave set-up, wave translation over the fringing reefs and sandflats, wave run-up and overtopping discharge of coastal defence structures.

As tide range is the dominant factor influencing inundation in Kiribati the most significant effect on coastal hazards such as inundation and erosion will be due to mean sea-level rise. Analysis of the SEAFRAME sea-level record provides a linear rate in sea level rise of +5.7 mm/yr (excluding any allowance for trends in atmospheric pressure and any vertical movement of the tide gauge platform) between 1993 and 2006. This rate is not necessarily an indication of an increasing rate of sea-level rise due to the influences of decadal and inter-decadal fluctuations in sea-level. Using

the entire sea-level dataset for Kiribati of approximately 33 years (from June 1974) suggests a linear rate of mean sea-level of 2.1 mm/yr, which is similar to global average rates.

The effects of sea-level rise will vary considerably between islands in Kiribati. For example, problems are likely to be greater for locations with smaller tide ranges in proportion to sea-level rise, where high tides will more often exceed current upper-tide levels. For example in the western Kiribati Islands, where the tide range is relatively high, present day Mean High Water Perigean Spring tide level (King tide level) would be exceeded by about 29%, 76% and 96% of all high tides, for rises in sea-level of 0.18 m, 0.59 m and 0.79 m respectively. However, for Kiritimati, where the tide range is much smaller, future sea-level rise has a much more significant influence. For Kiritimati, a sea-level rise of 0.18 m (the lowest range of the IPCC projections by the 2090s) results in 85% of high tides exceeding present day king tide levels. For a sea-level rise of 0.59 m all high tides will exceed present day king tide levels by at least 0.28 m and for a sea-level rise of 0.79 m by 0.48 m.

RAMSAY, THOMPSON & Others

Climate change effects on high intensity rainfall and drought in Kiribati

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The rainfall climate of Kiribati is extremely variable, and is influenced by the El Niño-Southern Oscillation phenomenon. A consequence of inherently variable rainfall is a climate that is prone to “drought”, or periods of below average rainfall. The effects of climate change over this century is expected to alter the rainfall variability within Kiribati and hence the characteristics of droughts that affect the islands. A warmer climate will also influence the intensity and patterns of rainfall with more intense rainfall events likely to occur.

The Kiribati Adaptation Programme (KAP) is being undertaken by the Government of Kiribati to reduce the country’s vulnerability to climate variability and change. The project is now in its second phase, with the objective to implement adaptation measures, and consolidate the mainstreaming of adaptation into national economic policy.

As part of the second phase of the KAP climate risk information is being developed to be adopted as national standards for options analysis and technical design work (“climate proofing parameters”), particularly regarding coastal and water related issues. This included developing an up-to-date understanding of the present knowledge on climate variability, what may change in the future and what uncertainties still exist. The focus was on understanding what this may mean for Kiribati in terms of extreme climate events, such as heavy rainfall and severe drought, as well as sea level rise and other coastal effects over this century.

Average temperatures in Kiribati are likely to increase by between 1.2 ºC and 5.6 ºC by the 2090s depending on how much greenhouse gases are emitted over the next few decades. This increased temperature will result in a general increase in the amount of rainfall in Kiribati, and in an increase in very heavy rainfall. Heavy rainfall could increase by up to about 7% for every degree centigrade of warming with larger increases in rainfall expected for shorter duration rainfall events compared to longer ones, especially for recurrence intervals up to 20 years. One consequence of the climate change scenarios is that the extreme rainfalls in the current climate could be expected to occur with reduced durations.

In Kiribati 70% to 80% of droughts last for up to 10 months duration although there is a sizeable fraction of droughts that persist for over a year. A frequency analysis of drought duration suggests droughts of 12 months duration are expected on average once every 5 to 10 years. Further, very persistent droughts (i.e. lasting for at least 2 years) do occur relatively infrequently and especially during La Niña periods, and can be expected on average once every 20 to 50 years. At present Global Climate Models do not provide a consistent picture on future changes in intensity and frequency for El Niño and La Niña events which are important in determining drought duration and severity in Kiribati. Although there is general agreement among the models for an increase in annual rainfall in the Kiribati region, this increase is often not large. Despite more rainfall in the future, drought frequency and severity in general is likely to stay much the same as present. There will be periods where droughts are more frequent and severe and periods when they are less so.

SAGAR & Others

Shallow water bathymetry mapping using a physics-based remote sensing approach for validation of tsunami inundation modelling in the southwest Pacific

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The local effects of the tsunami threat to island countries of the southwest Pacific are highly dependant on seafloor shape and bathymetry between the source of the tsunami and the affected area. Significant gaps in the shallow water bathymetry data surrounding many of these countries have been identified; a critical component for accurate numerical tsunami inundation modelling as part of a comprehensive risk assessment.

This study applies a physics-based bathymetry mapping approach using high resolution multi-spectral satellite data. The basis of the approach is an optimisation driven per-pixel estimation of a set of environmental variables, including water column depth, from a semi-analytical expression of sub-surface remote sensing reflectance.

The methodology for applying this technique is being tested over the northern reefs and shallow water system of the island of Tongatapu, Tonga. The initial results have been assessed against existing coarse resolution satellite bathymetry and marine chart data, and show good potential for the technique to deliver a higher resolution bathymetry product (2.4 m horizontal, 0.06 m – 1 m vertical), without comprehensive field work or knowledge of water or substrate properties.

Strategies for refining and validating the model have been discussed, in view of the methodology being used in the next stages of a more comprehensive tsunami modelling project. For this, remote sensing bathymetry will be used as an input to the numerical inundation modelling of the 2 April 2007 Solomon Islands tsunami event, where significant inundation field data exists, enabling validation of both the inundation and bathymetry models.

SINCLAIR & Others

Groundwater monitoring in atoll environments

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Access to freshwater resources in atolls is limited. Rainwater harvesting, groundwater and desalination are sources for freshwater water commonly relied upon. Desalination relies on increasingly expensive fuel and is unlikely to be a long-term solution. Rainwater harvesting, reliant on regular rainfall events is becoming less secure as extended dry periods become more frequent and rainfall patterns become more irregular. Whilst the shallow groundwater reserves of atolls are also fragile, they do however provide some security of water supply during extended dry periods, and is therefore being increasingly utilised.

Majuro (Marshall Islands) and South Tarawa (Kiribati) are two atolls with high populations and significant associated problems with water, wastewater and related health issues. These atolls rely on groundwater for a significant portion of their freshwater supply, both from public water reserves as well as from domestic wells. The populations on these atolls are increasing, placing even greater demands on already stressed water resources.

Development of these groundwater resources will continue into the foreseeable future. Abstractions as well as activities which may pollute the underlying groundwater are expected to increase. To offer both protection of the resource and access to the much needed land is becoming a challenge. Balancing these potentially conflicting interests will require improved communication between stakeholders and understanding of their needs, as well as additional management of the water resource, planning, and sufficient resources and time to implement.

Understanding how the groundwater system responds to the increased abstractions, climate variations, and potentially polluting surface activities, forms an important step in addressing needs of users and allow management options and solutions to be developed. Recent activities with SOPAC under the Pacific HYCOS project, in both Majuro and South Tarawa, have, over the last 5-11 months, focussed on improving the monitoring of the groundwater and its responses to impacts from climate, abstractions, and pollution sources.

The information collected reinforces the responsiveness of the groundwater system to rainfall, as well as its susceptibility from pollution. The data, whilst of limited duration, provides interesting insight into the response of the resource, and will help to shape what information and monitoring is required and how it may be collected in the future.

In most atolls, providing sufficient potable water is fundamental, with water quality being a key consideration. Horizontal gallery abstraction wells and most domestic wells are designed to skim water from the freshest part of the water lens. Whilst monitoring of water from these wells and galleries is useful for water supply purposes, and plays an important role in monitoring impacts from surface activities, they are of limited value in providing any information on the status or dynamics of the resource.

Groundwater monitoring in atolls requires sufficient information on the saltwater and freshwater interface to be collected to capture the responsiveness and behaviour of the system. Bacteriological and nitrate monitoring, both relatively easily undertaken, will allow assessment of

the impact from the most likely potential threat to groundwater from surface activities and would include sampling from the shallow domestic wells and galleries.

A model is proposed, within the constraints of the monitoring network and available resources, on the type and frequency of monitoring required for these two atoll environments which will both promote the usefulness of the data, and broaden the understanding of the resource, leading to improved water resource management.

SOALADAOB & NGIRCHECHOL

Improving water safety in Palau through strategic and comprehensive planning

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The Framework for Action on Drinking Water Quality and Health in Pacific Island Countries was developed by 18 Pacific islands and territories in 2005 to support the implementation of drinking water quality actions envisioned in the overarching Pacific Regional Action Plan on Sustainable Water Management. One of the actions formulated under this framework is the development and implementation of Water Safety Plans.

Water Safety Planning (WSP) as defined in the third edition of the WHO Guidelines for drinking water quality (2004) is a “Comprehensive risk assessment and risk management approach that encompasses all steps in the water supply from ‘catchment to consumer’ to consistently ensure the safety of water supplies”. A ‘Pacific Water Safety Plans Programme’ was initiated in late 2005 through AusAID funding to SOPAC and WHO. The Republic of Palau was selected as one out of four Pacific Island Countries to pilot the development of Water Safety Plans (together with Vanuatu, Tonga, Cook Islands).

The WSP process is a multi-sectoral approach that comprehends all factors that impact on water safety including catchment protection measures, improved treatment and storage of water, more efficient water distribution to households, and raising public awareness on hygiene and water protection and conservation. Through the establishment of an inter-sectoral WSP Steering Committee, the Water Safety Planning process in Palau brought together stakeholders involved with water and health in an unprecedented manner.

Through a systematic process of assessment and consultation, the WSP Steering Committee has developed a Water Safety Plan for the Koror-Arai water supply system. The Plan identifies key risks to water safety (including possible water source contamination or depletion, weaknesses in infrastructure, gaps in policy and operational protocol, etc.) with specific recommendations for measures and processes to manage these risks. At the national level, government officials, the private sector and non-government organisations are now planning for how to build on their individual strengths to better coordinate the responsibility for the delivery of safe water; and at the local level communities are working together to protect and maintain their own water systems.

This inter-sectoral and comprehensive approach to water safety has helped to highlight water as a major priority on the political agenda in Palau, and has raised awareness on issues related to water safety “from source to faucet”. Spurred by the progress made through the WSP process, a

proposal has now been put forward to expand the strategic planning process to support a wider reform for Integrated Water Resources Management (IWRM) to improve inter-sectoral coordination, participation and strategy for water resources management in Palau.

TALIA

Re-survey of Mulinu'u Peninsula Beach Profiles, Apia Samoa 2008

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The re-survey of the Mulinu'u peninsula is the continuation of the SOPAC – Apia Observatory task of monitoring the beach profiles of Mulinu'u peninsula (SOPAC Training Report 57, SOPAC Preliminary Report 76, SOPAC Preliminary Report 91) and the effects that the sea wall has on the beach area. It follows a recommendation of the previous report by Phillip Woodward (SOPAC) and Lameko Talia (Apia Observatory) in 1998 (SOPAC Preliminary Report 91) that the profiles continued to be monitored. Originally SOPAC conducted eight (8) profiles from Apia Observatory to the former Le Godinet Hotel from 1993, 1994 and 1998. Now the Geoscience Section (Geology and Geophysics) has added four more profiles plus underwater pictures and sample taking. The addition of four profiles will cover the whole peninsula from the market to the meteorology ground while the samples and photographs will assist with identifying sediments characteristics. The results are presented, discussed and further recommendations made.

TAWAKE

Deep sea minerals exploration and mining in the Pacific Islands Region: status, benefits and challenges

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Interests in deep sea mineral deposits have been rekindled in recent years in the south-west Pacific region due to the rise in metal prices triggered by sustained increase in global demand. New discoveries of high grade precious and base metals in Papua New Guinea territorial waters have provided the impetus for renewed interests in marine polymetallic deposits in the region that could spur a great deal of investment in deep-sea mining. Interestingly, the investigation of potential economic deep sea mineral deposits in the region was one of the core functions of the Pacific Islands Applied Geoscience Commission (SOPAC) in the 1970s.

The potential for seabed mining in the Pacific Island region is significant. All the three major types of polymetallic deposits that occur on the seafloor, namely the Manganese Nodules (MN), Seafloor Massive Sulphide (SMS) and Cobalt-rich Crusts (CRC) have been discovered within the Exclusive Economic Zones (EEZ) of many Pacific Island Countries. For instance, manganese nodules occur in the Cook Islands and Kiribati while cobalt-rich manganese crusts have been found in the Federal States of Micronesia and the Marshall Islands. In addition, seafloor massive sulphide deposits are discovered in the Lau Basin in Fiji and Tonga's EEZ, and in the Manus and Woodlark Basins in Papua New Guinea and Solomon Islands.

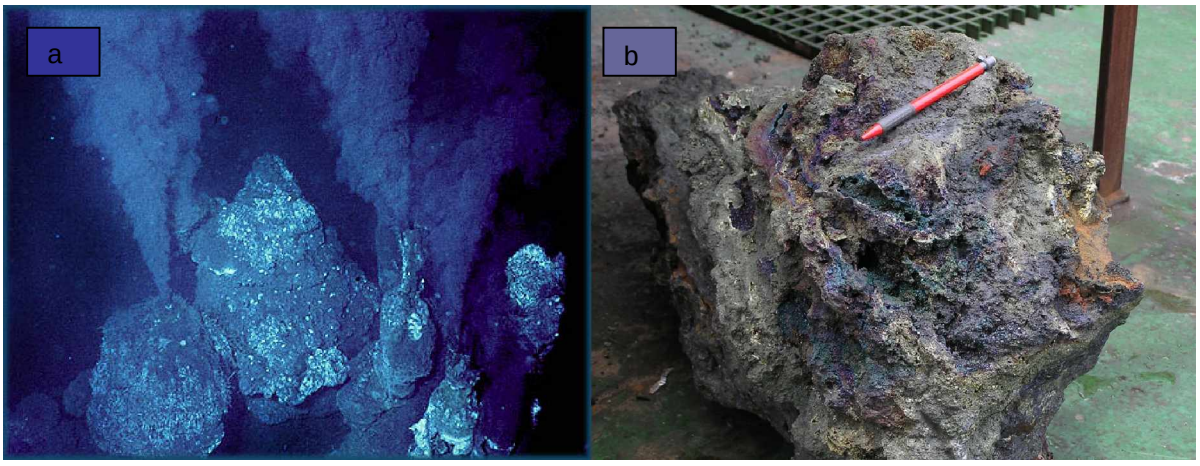

Figure 1. a) Active seafloor massive sulphide vent; b) An example of massive sulphide ore.

Currently, two offshore mineral exploration/mining companies are operating in the southwest Pacific region. Nautilus' exploration activity in Papua New Guinea has now reached an advanced stage where mining is imminent. It is poised to become the world's first undersea mining operations within its project site in the Manus Basin in Papua New Guinea. Secondly, Neptune Minerals, a United Kingdom company is conducting mineral prospecting in the Kermadec Ridge within New Zealand's EEZ. Both companies have substantial offshore exploration licence holdings in a number of countries in the region.

Existing legislations that govern the Territorial Seas, EEZ and continental shelf of individual nations are more or less a declaration of sovereign rights and to some extent ownership over the non-living resources of the seabed and subsoils. Most of the active mineral and mining legislation are heavily biased towards onshore exploration and exploitation with no or little mention of the offshore mineral resources. Additionally, legislations that deal with offshore resources are often designed to administer the ocean's living resources, particularly fishery resources, within their respective jurisdiction. Presently, apart from Papua New Guinea and Fiji, no other country in the region has taken the initiative in developing its offshore minerals policy.

The absence of specific legislation governing offshore mineral exploration and mining of individual nation is a matter of concern. A policy and regulatory vacuum for the development and management of seabed mineral resources of these countries exists warranting immediate attention and proactive approach. In recognition of the enormous potential of deep sea mineral resources within the Pacific region, SOPAC in collaboration with countries with interests in deep sea minerals in the region and donors collectively developed "The Madang Guidelines" as a basis to formulate effective and enabling policy and legislation to govern offshore mineral exploration and development.

Individual nations will need assistance in developing sound policy and legislation that safeguard interests within their respective jurisdiction, and are consistent with other domestic and international laws hence a collaborative approach is suggested. SOPAC endeavours to work closely with the World Bank and potential donor agencies in developing a regional regulatory and legislative framework that will ensure these deep mineral resources are harnessed for the maximum benefit of Pacific Island Countries (PICs). This will be followed by specifically looking at the fiscal and tax regime for deep sea minerals exploitation.

Ongoing collaboration among PICs will be encouraged to ensure the best possible systems are in place to generate maximum benefits for our national economies while protecting the long-term needs of our environment and communities. As the regional agency with the mandate for dealing

with non-living natural resources in the Pacific, SOPAC intends to play a key role in assisting the PICs develop the policy, legislation and technical support required to manage these important mineral resources.

Geological Assessment of Terrestrial Sources of Aggregates in Aitutaki and Mangaia Islands, Southern Cook Islands

The construction industry in the Cook Islands has significantly benefited from a booming tourism industry through the construction of hotels and resorts and retail trade. Additionally, this has resulted in related infrastructure upgrading such as roads, airstrips and water supply that require significant amount of raw construction materials including sand and gravel. Recently, traditional sources such as beach aggregates in Aitutaki and Mangaia Islands have been heavily targeted to meet increasing demand.

The island of Aitutaki is a popular tourist destination and the second most developed island in the country apart from Rarotonga. Construction activities are active on the island where significant amount of sand and gravel is being used for road works, tourism development and residential house construction. While there is abundant supply of inland sand resources on the island, the management of these resources needs improvement to ensure environmentally friendly extraction practice is realised. On the other hand, the onland quarrying operation is not only unable to meet the demand for coarse aggregates but the resource at the quarry site is becoming depleted.

Figure 1. Identified aggregates resources: a) Mania basalt outcrop in Aitutaki; b) the Karanga limestone escarpment in Mangaia.

Mangaia Island, on the other hand, is the second largest island in the Cook Islands but relatively underdeveloped. Recently, the island has been experiencing sand and gravel supply problems due to the construction of a school building and a hotel between 2006 and 2008. The hotel is still under construction and is probably the biggest infrastructure development on the island. While the potential of the limestone as sources of construction sand and gravel is huge, the lack of sand resources on the island has been a major problem. Further, the inability of the quarrying operation to supply aggregates warrants a review of the operation in order to improve production.

This shortfall in the supply of construction aggregates has put pressure on traditional sources of sand and gravel, particularly the coastal zones of these islands. At the request of the Cook Islands Government, SOPAC embarked on the identification and assessment of alternative

terrestrial sources of aggregates in Aitutaki and Mangaia between 2007 and 2008. In agreement with the government, the work in Aitutaki concentrated on identifying suitable source of coarse aggregates whereas sand and gravel sources were targeted in Mangaia.

The results of the investigation reveal that Mangaia has more than adequate rock materials in the form of partially recrystallised limestone and to a lesser extent fresh basalt that can be crushed to produce sand and gravel for construction. Generally, the massive raised limestone is of reasonable quality but selective extraction of the fresh basalt flow will guarantee high quality aggregates. The geotechnical test results indicate that the range of aggregate types in Mangaia can be used in many construction applications hence they can be exported to other islands in the country once the quarry operation is overhauled.

Aitutaki on the other hand has adequate source of coarse aggregates in the short to medium term. The identified terrestrial sources on the island can produce moderate to high quality aggregates that are suitable for various applications. For the long term supply of coarse aggregates for Aitutaki, the importation of crushed aggregates from Rarotonga and/or Mangaia is recommended.

Reference:

Tawake, A. K. 2008. Technical Report on the Assessment of Selected Aggregates Sources on the Islands of Aitutaki and Mangaia Southern Cook Islands (Draft). EU EDF8 – SOPAC Project Report.

TEHULU & Others

Tracking rainwater with GIS in Tuvalu

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With a land area of only 1.4 sq kms, the capital of Tuvalu, Funafuti, relies almost exclusively on the collection of rainwater for the freshwater needs of its population of around 5,000. The coarse coral sands that dominate the geology of Funafuti, and the small extents of the islet, being only 20 – 400 m wide, means that the potential for fresh groundwater is not available.

Recent initiatives through AusAID and the European Union will see the delivery of over 600, 10,000 L rainwater storages to houses and government residences. A survey in October 2008 of rainwater storages in Funafuti, was undertaken by SOPAC, to both identify the existing volume of storage available and to assist current and future programs in the implementation of rainwater collection and storage interventions.

All roofs were digitised using QuickBird pan sharpened imagery with 60 cm resolution from 2006, forming the basis for a GIS and further survey work. Some 770 roofs were followed up with surveys, the remaining roofs from the 940 digitised, being piggery sheds and like, with limited potential for rainwater collection, and were not included.

Teams from PWD and SOPAC, surveyed the buildings for potential to capture, transfer, and store rainwater. Information on roof and guttering condition, size of storages, use of water, and

supporting information such as number of people living in the house, access to alternate water supplies and wastewater disposal was recorded. This was then further characterised into community, government, residential and commercial collection and storage systems.

Whilst government transports water from strategic supplies to residences, the survey identified that less than 15% of all available rainwater storage is owned by government, suggesting limited capacity for government to support the population during extended dry periods. Private residences account for about 70% of all available storage volume. The survey identified that less than 65% of all roofs have sufficient guttering to capture all runoff, and that about 50% of all guttering inspected is in need of repair or replacement.

It is hoped that this GIS and database will assist to shape interventions into increasing drought resilience in Funafuti. The GIS spatial and temporal capabilities provide the potential for adding additional layers of information including deliveries of water, and water quality sampling. There is potential to identify houses of high water demands, and linking water quality with water borne disease outbreak.

A joint initiative to sample water and survey houses with Ministry of Health and PWD is currently being promoted to further encourage the collection of relevant information, the sharing of resources and promote accessibility of information to improve water supply, and management in Funafuti.

ENDNOTE
Attached is the Final Programme of the 25th Session of STAR

PROGRAMME FOR THE 25th SCIENCE, TECHNOLOGY & RESOURCES NETWORK MEETING, 22nd – 24th OCTOBER 2008

Government Building, Funafuti, Tuvalu

Time	Theme	Authors & Speaker	Title
Tuesday October 21st			
17:30-18:00	STAR Opening	Hosted by The Secretary for Foreign Affairs & Labour, Mr Enele Sopoaga	
18:00 -	Social gathering		
Wednesday October 22nd			
09:00-09:20	Water Resources	Burn, S.	Water service provision in the Pacific - the role of community and engagement
09:20-09:40		Sinclair, P., Antoniou, A., Cyr, M. & Hicking, A.	Groundwater monitoring in atoll environments
09:40-10:00		Panapa, P.	Integrated Water Resources Management in Tuvalu
10:00-10:20		Tehulu, A., Molipi, L. et al.	Tracking rainwater with GIS in Tuvalu
10:20-10:50	Refreshment break		
10:50-11:10	Water Resources	Ioan, C.	Water governance in Vanuatu
11:10-11:30		Finau, M. & Sinclair, P.	Monitoring the effects of mineral water abstraction on Fijian groundwater systems
11:30-11:50		Soaladaob, I. & Ngirchechol, M.	Improving water safety in Palau through strategic and comprehensive planning
11:50-12:15		Ramsay, D.L, Thompson, C., Mullan, B., & Kaitara, K.	Climate change effects on high intensity rainfall and drought in Kiribati
12:15-12:35	Power	Lotolua, M.	40 kW Grid-Connected Solar PV System in Tuvalu
12:35-13:30	Lunch break		
13:30-13:50	Water & Sanitation	Molipi, L. & Crennan, L.	Ecosanitation in Tuvalu - one solution to many problems
13:50-14:10		Homasi, A. & Hodgson, A.	Establishing partnerships for addressing sanitation in partnership – the WASH coalition
14:10-14:30		Ramsey, D., Tanner, C., & others	Sustainable water supply & waste treatment systems for a coastal Fijian village
14:30-14:35		Chand, P.	Rotomould water tanks
14:35-14:55	Remote Sensing	Forstreuter, W. & Archbold, M.	Reference image points
14:55-15:25	Refreshment break		
15:25-15:45	Remote Sensing & Monitoring	Cocker, E.	Haze removal and atmospheric correction of satellite images
15:45-16:05		Forstreuter, W. & Papao, J.	DEM establishment through RTK GPS for beach movement monitoring, example Marshal Islands
16:05-16:25		Sagar, S., Wettle, M. & Damlamian, H.	Shallow water bathymetry mapping using a physics-based remote sensing approach for validation of tsunami inundation modelling in the south-west Pacific
16:25-16:45		Forstreuter, W.	Overlay analysis in Raster Data Environment for water catchment monitoring, example Solomon Islands
16:45-17:05	Minerals	Ambroz, A.	An economic feasibility assessment of lagoon dredging in Funafuti
17:05-17:30		STAR Business Meeting	
Evening	Meetings of Working Groups		

Thursday October 23rd			
09:00-09:25	Remote Sensing & Mapping	Cocker, E.	Shallow water bathymetry utilizing satellite images
09:25-09:45		Forstreuter, W.	Utilisation of TerraSAR-X image data for coastal mapping
09:45-10:05	Ocean & Coastal Processes	Greene, H.G.	The influence of freshwater on the marine system – impacts at the terrestrial-marine interface and lessons learned in San Juan Archipelago and application to the SOPAC Region
10:05-10:25		Collen, J.D., Garton, D.W., Gardner, J.P.A. & Dunbar, R.B.	Geochemical and biological evidence of anthropogenic environmental changes to Palmyra Atoll lagoon, northern Line Islands
10:25-10:55	Refreshment break		
10:55-11:15	Ocean & Coastal Processes	Collen, J.D., Gardner, J.P.A. & Garton, D.W.	Application of the littoral cell concept to managing a protected atoll: Palmyra Atoll National Wildlife Refuge, northern Line Islands
11:15-11:40		Ramsay, D.L., Stephens, S.A, Gorman, R., & Kaitara, K.	Climate change effects on sea levels, waves, run-up and overtopping in Kiribati
11:40-12:00		Kruger, J. Sharma, A., Kumar, S., George, N. & Roelfsema, C.	Shallow water marine habitat mapping, Aitutaki, Cook Islands
12:00-12:20		Damlamian, H., Cummins, P., Burbridge, D., Thomas, C. & Sagar, S.	Tsunami and inundation modelling in the South Pacific
12:20-13:30	Lunch break		
13:30-13:50	Ocean & Coastal Processes	Kruger, J. & Damlamian, H.	Hydro-environmental survey and modelling of an enclosed lagoon, Aitutaki, Cook Islands
13:50-14:10		Murata, A.	Hydrographic observations Along 17°S Line in the South Pacific: re-occupation of WHP P21 Section
14:10-14:35		Ramsay, D.	Tuvalu reef channels
14:35-14:55	Minerals	Tawake, A.	Deep sea minerals exploration and mining in the Pacific Islands Region: status, benefits and challenges
14:55-15:20		Tawake, A.	Geological assessment of terrestrial sources of aggregates in Aitutaki and Mangaia Islands, southern Cook Islands
15:20-15:50	Refreshment break		
15:50-16:10	Water Resources	Kofe, S.	Overview of key issues in water resources management of the Pacific
16:10-16:30	Remote sensing & boundaries	Malologa, F.	Satellite imagery for cadastre and coastal monitoring on Niutao, Tuvalu
16:30-16:50		Malologa, F.	PIRMBIS as a negotiating tool for maritime boundaries
16:50-17:10	Misc.	Burns, S.	The role of condition assessment in asset management
17:10-17:30	Discussion and Closing Session		
Evening	Meetings of Working Groups		

Friday October 24th
A.M.: Presentations for Forms 2-5 students Meetings of working groups: Benthic marine habitats: convenor Gary Greene Energy: convenor Paul Fairbairn Water: convenor Rhonda GIS & RS: convenor Litea

Session chairs:

Annie Homasi
Faatasi Malologa
John Collen
Loia Tausi
Molipi Tausi
Teuleala Manuella