

ABSTRACTS OF PAPERS PRESENTED AT THE STAR* SESSION 2012

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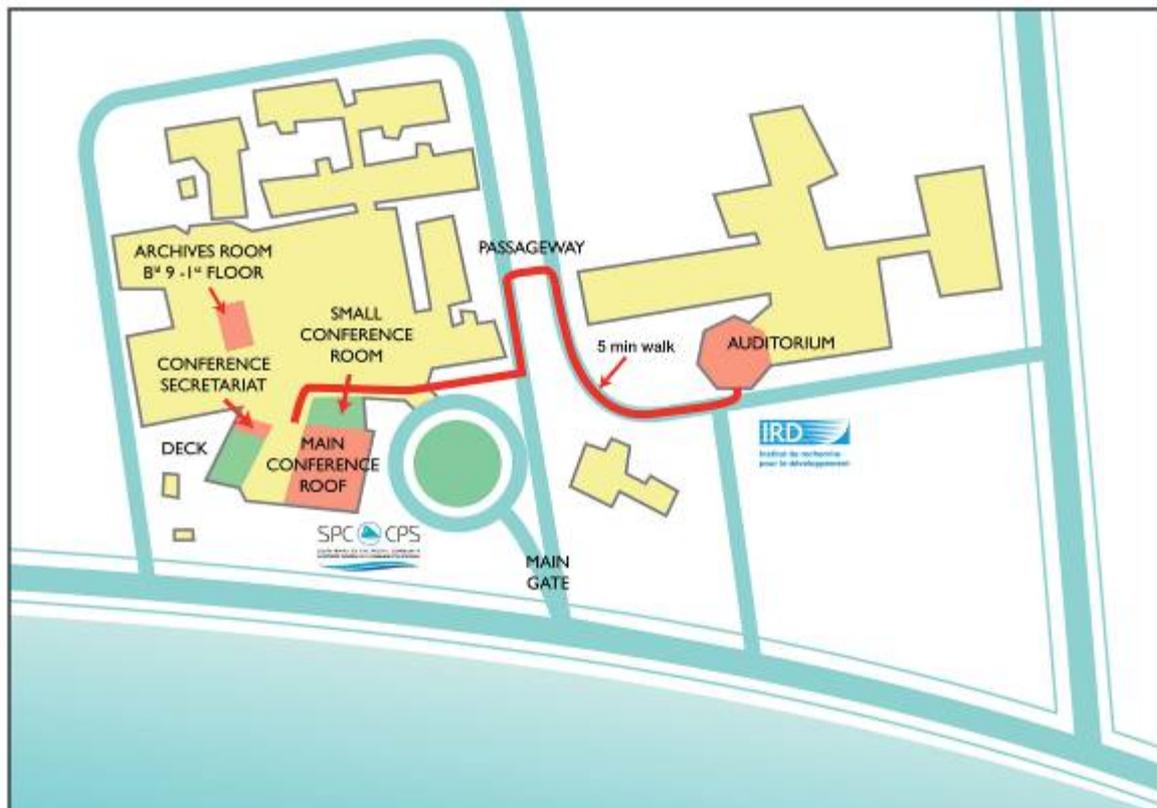
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Note from compilers

Abstracts included in this volume were received up to the close of business on Monday, 15 October 2012. Abstracts received later than this date will be made available in loose leaf format at the meeting rooms on the day of the corresponding presentation and will be published in the Post-session version of this document.

FOREWORD

Now that SOPAC is established as a Division of the Secretariat of the Pacific Community (SPC), it is pertinent to review the role that STAR has played in its evolution over the past 25 years and consider possible scenarios for the future. STAR (the Science, Technology and Resources Network) was founded in 1985 in collaboration with the International Oceanographic Commission, to facilitate the continuing provision of advice to SOPAC by the international geoscience community. The first Chair of STAR was Charles Helsley, then Director of the Hawaii Institute of Geophysics. He was succeeded in 1992 by Keith Crook from the Hawaii Undersea Research Laboratory and, in turn, John Collen from Victoria University of Wellington became Chair in 1999.

Apart from giving advice, facilitating research in the region and sponsoring workshops and meetings, STAR organised an annual conference each year in conjunction with the annual meetings of SOPAC's Governing Council. The STAR conferences were not simply technical conferences at which individuals presented and discussed scientific papers, as participants had the additional responsibilities of formulating advice to SOPAC about its work program and highlighting technical and scientific issues of particular importance or urgency to the region. This advice, as reports and recommendations from STAR Working Groups and summaries of highlights of STAR technical presentations, was formally presented to Council through an address in Plenary by the Chair of STAR and during the Governing Council/Technical Advisory Group (GC/TAG) segment of the Annual Sessions.

SOPAC's role in the Pacific region evolved continually since its formation. A fundamental and essential strength throughout, though, was its ability to mobilize multidisciplinary science to address the national needs of its island member countries. The long-established working relationship between SOPAC and the international research community was a vital element in this endeavour, and much of this was focussed through STAR. This voluntary association saw the interests of STAR members and the themes of the annual meetings change similarly through time. In earlier years STAR was primarily concerned with "blue-water" marine geoscience, tectonics and resource exploration and evaluation. However, as national needs and priorities changed, the scope of STAR similarly expanded. During the 1990's STAR supported the changes in SOPAC's scope and focus that led to the development of the three major work programmes. From 2005, Programme Monitoring and Evaluation Groups (PMEGs) composed of STAR/TAG scientists 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. This was deliberately intended to allow wider and more detailed participation of international scientists in assisting SOPAC's work, as well as providing SOPAC with independent monitoring of and feedback on its programmes.

The Regional Institutional Framework (RIF) process led to a number of uncertainties for STAR as well as for SOPAC. However, SPC has pledged its full support to STAR, and other regional technical organisations have expressed similar sentiments. Since 2010, STAR sessions have been held jointly with the Circum-Pacific Council for Energy and Mineral Resources, and this year will link with a technically-oriented SOPAC Division meeting. Further, participants from other Divisions of SPC and from the wider Pacific science community are invited to the STAR Conference. Thus, the opportunity exists to not only continue this long-term relationship but to widen STAR's endeavours in Pacific science in collaboration with and for the benefit of the SOPAC nations. STAR will continue to support the work of SOPAC and associated organisations in the Pacific region and, as in the past at Governing Council meetings, give what support and advice we can to the new Division at its annual meetings. In that respect, the participation of all STAR delegates as technical advisers during the SOPAC Divisional Meeting that overlaps and follows this conference is welcomed.

The theme of this the 29th STAR Conference in Noumea is "The science of a changing world: addressing Pacific issues through the 21st Century". The abstracts in this volume relate to this important theme but, as has become traditional at STAR conferences, also cover a wide range of other relevant research.

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ABSTRACTS OF PAPERS

ALLENBACH & OTHERS

Presentation of the French National Climate Change Observatories Network IFRECOR

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The paper will describe one of the objectives of the National Action Plan IFRECOR (French Initiative for Coral Reef) 2011-2015. IFRECOR is a national policy instrument focusing on coral reefs and their associated ecosystems in French overseas territories. Since 2000, this program is designed and implemented through five-year plans at local, national and international levels.

All the IFRECOR actions contribute to a better understanding and management of French coral reefs spread over the three oceans. Six strategic axis are defined within IFRECOR framework:

1. Planning of IFRECOR actions;
2. Reducing negative impacts of human activities and promote sustainable development;
3. The development of research, monitoring and decision support tools;
4. Information, training and education;
5. The development of regulation policies and financial tools; and
6. The development of local and regional cooperation.

The National Action Plan (NAP) IFRECOR for 2011-2015 set up a TIT (transverse thematic area of interest) on "Adapting to climate change" in 2011. Its long term goal is to benefit from the IFRECOR actions and recommendations to raise awareness of economic actors and policy makers on reef environments and associated ecosystems, with the view to contributing to the design of appropriate plans for overseas regions. It is also to proposing specific technical, measures scientific for socio-economic development. It also aims to encourage French overseas communities to define a strategy for adapting to climate change taking into account the reef environments.

This creation is a continuation of actions already undertaken and under the umbrella of TIT "Monitoring networks". Communication is to present the network and indicators. Carried out by Wallis and Futuna Department of Environment (South Pacific) with the support of S2C consultant, University of New Caledonia (UNC) and the National observatory on the effects of global warming (ONERC) various products are made et visible on scientific interoperable portal developed within the University of New Caledonia (<http://portail-scientifique.univ-nc.nc>). It provides access to data compiled in the different French overseas territories on indicators identified to be relevant to assess climate change in reef environment (sea surface temperature, acidification, coastal development, state of health of the reefs). This portal has been designed following the recommendations of ONERC.

AUCAN

Historical sea level change in Nouméa 1967 – present

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Sea level has been measured hourly at Pointe Chaleix in Noumea, New Caledonia, since 1957. These measurements are in digital form since 1967, and efforts are underway to digitize the 1957 – 1967 paper dataset. In 2005, measurements stopped at Pointe Chaleix as the tide gauge was decommissioned, and a new tide gauge was commissioned nearby at Numbo.

Here we first join the past and current sea-level datasets to produce a continuous, homogeneous, hourly, 1967 to present sea-level timeseries in Noumea. We use this new time-series to calculate daily and monthly mean sea-level and to investigate long-term and interannual sea-level change in Nouméa. Over the entire period 1967-2012, the linear rate of sea-level increase is 0.67 ± 0.5 mm/yr. However, interannual changes of monthly mean sea-level can be much larger (and positive or negative). We then attempt to relate these interannual changes to large scale climate indices to better forecast mean sea-level changes in the New Caledonia region.

CAO-LORMEAU

Dengue risk and emerging arboviruses management in the Pacific (DREAM Pacific): outlines of a future project dedicated to emerging arboviruses in Pacific Island Countries and Territories.

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For more than 50 years the Pacific is regularly experiencing epidemics due to mosquito borne viruses, with dengue being at the top of the list of the most widespread arboviruses in Pacific Island Countries (PICs). Globalization and intensification of human travels have contributed to increase the frequency of introduction of new DENV serotypes into the Pacific and have shortened the time needed for these viruses to be distributed between PICs. With the major DENV vector, *Aedes aegypti*, being present in the most inhabited islands and, several endemic mosquito species proven to act as secondary vectors in less urbanized settings, DENV is still a major public health concern in PICs awaiting more efficient vector control strategies, a vaccine and anti-viral therapeutics. The threat of the emergence of other mosquito borne viruses has also strongly increased during the last decades. Epidemics due to Ross River Virus have become more and more frequent in Australia, with sometimes a spread to other PICs (several islands in the 1980s and at least Fiji in the early 2000 years). Recently, human cases due to local transmission of chikungunya virus have been reported for the first time in New Caledonia. What about the risk for West Nile virus (WNV) that caused in last September the largest outbreak ever reported in the United States? Do some of the mosquito species present in the PICs might be efficient vectors for WNV? In the expectation to better evaluate the risk of arboviruses emergences in the Pacific and in order to provide local authorities with biological and entomological indicators to better anticipate and manage potential future outbreaks in their country, the knowledge gaps, the weaknesses in the surveillance systems, the difficulties in data production and sharing needed to be identified. To that aim, actors of both public health and research on arboviruses in the Pacific

were invited to share their expertise and knowledge within the framework of a workshop organized by the Institut Louis Malardé, Tahiti, French Polynesia, from 3-5 September, 2012. Invited participants were: (1) basic science researchers (entomologists, arbovirologists, climatologists, epidemiologists) mostly from academic research institutions situated in the Pacific (Australia, Fiji, French Polynesia, Hawaii, New Caledonia, New Zealand, Papua New Guinea); (2) representatives of public health organizations involved in the surveillance and support to PICs (WHO, SPC, CDC); (3) representatives of local public health authorities (Directions of Health in French Polynesia and New Caledonia); (4) the staff from public health laboratories in some PICs (Yap FSM, Majuro-RMI, Tonga). These three days of conferences and workgroup sessions have resulted in designing the outlines of a future scientific project that would address both fundamental and operational aspects of arboviruses emergence in the region: the DREAM Pacific project.

COLLOT & OTHERS

Seismic stratigraphy and tectonic history of the Southwest Pacific

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A regional cooperation program between New Caledonia, New Zealand and Australia has led to the compilation of c. 100,000 line km of seismic reflection data from a continental region that covers an area of c. 3,000,000 km². We present a seismic stratigraphic chart at the scale of the southwest Pacific that summarises our interpretation of the dataset. Our new seismic stratigraphy regionally identifies five coherent mega-units. These mega-units record the tectono-stratigraphic evolution of the southwest Pacific from Mesozoic fragmentation of the eastern Gondwana margin to Cenozoic subduction and associated marginal sea development. Unit 5 corresponds to the Phanerozoic pre rift sedimentation along the Gondwana active margin; Unit 4 is the Cretaceous syn rift sedimentation related to the first stages of fragmentation of the Eastern Gondwana margin among which the opening of the Tasman Sea; Unit 3 corresponds to a passive post rift sag sedimentation; Unit 2 records the Eocene onset of regional compression and uplift interpreted to be related to the initiation of the Tonga Kermadec subduction zone and Unit 1 marks subsidence and a return to tectonic quiescence interpreted as the consequence of the slab roll-back of the Tonga-Kermadec subduction. This regional stratigraphic chart and associated geological events presents a new starting point for geodynamic studies of the SW Pacific as well as for local basin-scale studies.

CRAVATTE & OTHERS

Achieved and expected scientific advances from the Southwest Pacific Ocean Circulation and Climate Experiment (SPICE)

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SPICE is an international research project under the auspices of CLIVAR (Climate Variability and Predictability) to comprehend the southwest Pacific Ocean circulation and its direct and indirect influence on the climate and environment. It was designed to measure and monitor the ocean circulation and the South Pacific Convergence Zone (SPCZ), to validate and improve numerical models, and to integrate with assimilating systems. South Pacific oceanic waters are carried from the subtropical gyre centre in the westward flowing South Equatorial Current (SEC), towards the southwest Pacific—a major circulation pathway that redistributes water from the subtropics to the equator and Southern Ocean. The transit in the Coral Sea is potentially of great importance to tropical climate prediction because changes in either the temperature or the amount of water arriving at the equator have the capability to modulate ENSO and produce basin-scale climate feedbacks. The circulation is complex, with the SEC splitting into zonal jets upon encountering island archipelagos, before joining either the East Australian Current or the North Queensland Current towards the equator. We review here the ongoing progresses and the potential for improving climate simulation and prediction on seasonal to decadal timescales.

DAMLAMIAN & CUMMINS

Sensitivity analysis of tsunami inundation modelling with respect to baseline data: Nuku'alofa, Kingdom of Tonga

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The absence of good quality baseline data is very common in the Pacific region, and modelling investigations are often based on available data due to the cost involved in the acquisition of new bathymetric and topographic data. Applying such an approach to tsunami evacuation mapping can lead to catastrophic scenarios, hence the increased availability of free and user friendly tsunami modelling tools becomes relevant in this situation. As part of the AusAID-funded project *Capacity Building for Tsunami Risk Assessment in the South West Pacific – Phase 3*, a collaboration between the Secretariat of the Pacific Community (SPC) and Geoscience Australia (GA), a sensitivity study of tsunami inundation modelling for Nuku'alofa using GEOCLAW was carried out to investigate how the error in the baseline data propagates onto the modelling output. While the results cannot be applied to other sites, they are valuable as an indicative. This study was made possible by the use of recently collected **light detection and ranging (LiDAR)** data over Tongatapu, funded by the Australian Government. Predicted inundation using LiDAR baseline data was taken as reference and compared with model output using other sources such as multibeam echosounder data, real time kinematic GNSS data and satellite derived bathymetry from SAMBUCA. Results show a percentage of error for each data source depending on bottom friction and tsunami wave height. Additionally, we discuss the error that could potentially be propagated into hypothetical evacuation maps.

DAMLAMIAN & KRÜGER

Cyclone wave inundation risk mapping in Rangiroa atoll, French Polynesia

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Tropical cyclone events are known to be a major source of risk in the Tuamotu Archipelago, French Polynesia, with recent destructive events in 1878, 1903, 1906, as well as five events in the 1982-1983 cyclone season. The inundation due to combined storm surge and wave setup is a major risk in atoll environments such as on Rangiroa where land elevation is in the order of metres. A previous study undertaken by the Government of French Polynesia in collaboration with the French Bureau of Geological and Mining Research (BRGM) established that the characteristic cyclone wave for risk mapping and urban planning in the Tuamotu has a significant wave height of 12 m and a wave period of 13s. Such a wave is believed to have a return period lower than 25 years. As part of the European Union-funded Overseas Countries and Territories (OCT) project: *Supporting disaster risk reduction in Pacific overseas countries and territories*, the SPC (via the SOPAC Division) in partnership with the Government of French Polynesia undertook a data collection campaign in the atoll of Rangiroa as well as four other atolls of the Tuamotu Archipelago namely – Kauehi, Manihi, Arutua and Apataki. New bathymetric, topographic and oceanographic data collected was used to model cyclone wave impact and should improve the accuracy and confidence of present risk zoning. A succinct sensitivity analysis using the open source XBeach software shows the dominance of 4 parameters: the flow friction coefficient (cf), the wave dissipation coefficient (alpha), the breaker parameter (gamma) and the bed friction parameter on wave actions (fw). Calibration was performed on those parameters. A final set of parameters was attributed by finding best compromise between calibration the result and the previous similar study. This talk will describe the methodology of the modelling study as well as present the first outputs.

DESCLOUX & OTHERS

Climate-based models for understanding and forecasting dengue epidemics in New-Caledonia and perspectives for the South Pacific area

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Dengue dynamics are driven by complex interactions between human-hosts, mosquito-vectors and viruses that are influenced by environmental and climatic factors. The objectives of this study were to analyze and model the relationships between climate, vectors and dengue outbreaks in Nouméa (New Caledonia), and to provide an early warning system. We analysed epidemiological, meteorological (1971-2010) and entomological data (2000-2009) at monthly, seasonal and inter-annual scales. We modelled dengue annual risk by using climatic variables measured at the

beginning of the transmission period (explicative model), or preceding it (predictive model). In Nouméa, dengue is highly seasonal with episodic epidemics occurring every 4 to 5 years. Seasonally, the epidemic peak is in phase with precipitations, relative humidity and entomological indices, and is lagging one month behind the temperature peak. At inter-annual scale, dengue risk is correlated to climatic variables, but not with ENSO. Multivariate models allowed identifying several climatic conditions that favour dengue outbreaks. The best explicative meteorological variables were the number of days with maximal temperature exceeding 32°C during January–February–March and the number of days with maximal relative humidity exceeding 95% during January. The explicative and predictive models yield 85% and 72% of right prediction respectively. Based on climate change scenario from IPCC-AR4, the dengue model is also used to assess the evolution of dengue risk in New-Caledonia for the next century. We show that Dengue is likely to evolve from epidemic to endemic situation. A similar approach will be developed to improve dengue management in other islands of the South Pacific in the frame of a regional funded project.

FORSTREUTER

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

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“Reference Image Points” are ground control points or points for which X and Y coordinates are known and which are visible on an image. RIP have been established for Pacific islands to be able to rectify very high resolution image data, which often do not fit into the projection even though they are purchased as geocoded products. The RIPs established are documented and placed on the web for everybody’s use. How to establish RIP is described in Pacific Islands GIS&RS Newsletter, Number 2 (November 2008), accessible at the SOPAC Division website.

New Demand for RIP

RIPs have been used to geometrically re-correct very high resolution (VHR) image data when producing image backdrops at

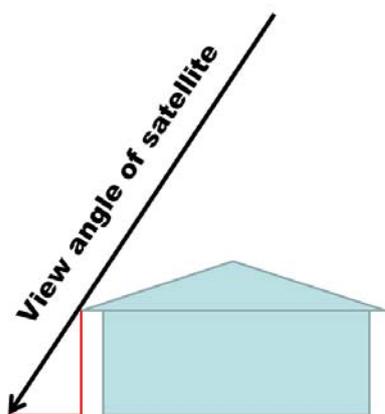


Figure 2: The distance between ground and roof corner has to be known to calculate with the view angle the displacement of the RIP.



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

1:5,000 scale with metre accuracy. Now VHR image data will be also utilised to create digital surface models (DSM) at 1:10,000 scale level with 3-5 m contour line intervals. It is possible to calculate DSM from stereo images. SPC-SOPAC Division is official re-

seller for DigitalGlobe and currently a stereo pair is offered at a price of only USD 15 per km² for the image data. The DSM calculation also needs RIP, however, the original methodology has to be changed as a Z coordinate, in addition to the X and Y coordinates, is required.

New Measurement Method for RIP

The first DSM derived from VHR stereo image data was created for a part of Samoa using GeoEye image data. Not all RIPs collected were usable as the height was only measured in the way required for exact X and Y positions but not sufficient to determine the exact Z position. Normally roof corners are an ideal feature for RIP as they are clearly visible in image data and the position can be determined easily with survey grade GPS equipment (see Figure 1). New is that for the Z position determination a) the distance between antenna and roof corner; and b) the distance of roof corner to the ground has to be measured to cm precision. The latter is essential for image data not recorded from the nadir, where the displacement has to be calculated from the sensor angle (see Figure 2) and distance between roof corner and ground.

Optimal RIPs are collected directly on the ground such as on a runway or a street marker, but these features are often not available in outer islands.

Software Requirements

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

Requirements from Pacific Island States to Establish RIPs and DSMs

RIPs are required for several applications where only image rectification and absolute orientation of DSMs are discussed in the presentation. If survey grade GPS equipment is utilised in Pacific island states it is often only a little additional effort to establish a few RIPs. Corresponding departments in Pacific Island Countries have to request for training in RIP establishment.

DSM establishment requires software and capacity building at the SOPAC Division, which only can be put into the annual work plan if there is a request from Pacific island states for DSMs. DSMs at 1:10,000 scale are mainly necessary for atoll countries.

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

Unmanned Aerial Vehicles (UAVs) are derived from military applications for reconnaissance mapping. These vehicles are increasingly utilised in areas where airborne and space borne image data have limitations. Beach profiles could be one of these areas as other earlier methods to monitor change of beach surface failed.

Beach Profiles

Due to changes of sea currents between El Niño and La Nina phenomena (and other reasons) the shapes of Pacific islands are permanently changing. This is a natural process in which sand drifts away on one side and accumulates on another side of an island. There is a need to document current land movement in order to predict future movements. In addition, the impact of sea-level rise could be documented in a quantitative way.

Beach profiles had established through conventional surveying methods in the eighties, where the beach heights were measured along a line established 90 degrees to the coastline. With the launch of IKONOS satellite with sub 5 metre resolution and DGPS survey it was possible to establish accurate reference data of the islands. This reference layer allowed geometric correction of historical aerial photographs, which were used to document the changes on islands' surfaces in the last few decades. RTK GPS enabled the creation of a digital elevation model (DEM) of 20 cm contour lines absolutely referenced to the world wide grid UTM WGS84. This can be a reference to calculate the change in cubic metre volume rather than just documenting the area change when the next RTK GPS survey is carried out.

Requirements of DEM Establishment

The DEM established through RTK GPS fulfilled all requirements regarding the DEM a) contour lines of 20 to 30 cm intervals, b) UTM WGS84 absolute orientation, c) scale of 1:10,000 to 1:5,000 and d) the possibility to create the first DEM on a laptop computer on the islands for control of overall coverage; however, the establishment was very time consuming. The DEM requires GPS survey points of a grid of about 4 metre grid cells and about 5 minutes recording at every grid point. The daily area coverage is therefore low. It was not possible to delegate the survey to local specialists as the data post processing at the end of each day requires in-depth technical understanding of GPS data and software handling. UAVs also fulfil all DEM requirements, require one to two specialists which cannot be recruited at the islands but have one important advantage, which is the much larger area coverage.

Requirements and Potential of UAVs

UAVs can be transported from SOPAC Division, Suva, with the plane as normal baggage like the RTK GPS. It can be re-assembled at the beach and operated by the specialists, where it is currently not fully clear if two specialists will be required for all systems on the market. The survey itself is relatively faster, as several km of beach profile can be covered quickly, which reduces the time specialists spend on the islands significantly, compared to a typical RTK GPS survey. Nevertheless, some time is necessary to prepare each part of a beach for the survey as follows:

- 1) For beach portions with pure sand, small stones have to be positioned to be utilised as reference points within the stereo coverage.
- 2) A few of these stones or other features visible in the image data have to be surveyed as X, Y and Z coordinates, which are required for absolute orientation of the DTM.
- 3) There has to be GPS base station with 24-hour survey to identify its own position or it has to be placed on a known surveyed point.
- 4) If the beach is further away than 15 km from the base station, a second base station has to be established closer to the survey area.
- 5) A landing area for the craft has to also be prepared.

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

The system cannot be operated with stronger winds or rain; however, as opposed to a normal plane, cloudy conditions are more an advantage than disadvantage.



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



Figure 2: Fixed wing type UAV (photo Wikipedia)

During the Pacific Islands GIS&RS User Conference it will be discussed if there is a need to mount a metric camera in the plane or if a “normal” camera of good resolution is sufficient and how far GPS vehicle motion detection is necessary to create image data usable to establish a DTM with conditions defined above. These two specifications of camera and GPS divide the available UAVs into two classes where most probably the smaller ones will be unsuitable where fixed wing types (see Figure 2) seem to have advantages to fulfil the requirements compared with helicopter types (see Figure 1).

Requirements from Pacific Island States to Conduct UAV Beach Survey

To be able to conduct a beach profile survey in the described way it is essential that the air traffic control authority of the corresponding island state allows operating an UAV up to 50 to 80 metre altitude. A UAV survey is probably uneconomic if the operator has to hold a pilot license as required in some countries.

Finally, Pacific states would have to express the demand to monitor beach profiles in this manner before SPC can plan the investment in capacity building, hardware and software.

FORSTREUTER & BATAUA

Land Cover Change Mapping for Low Lying Islands, a Quantitative Approach

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

Data

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

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

Method to Map the Change

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

The vector data of the satellite image based vegetation mapping were first summarised to the number and content of classes shown on the

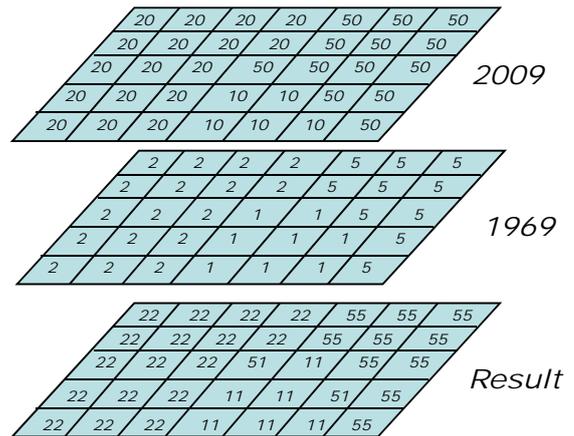


Figure 1: Overlay in raster data environment. The pixel values of the 2009 layer are multiplied by 10 before the values of both layers are added and stored in layer Result. The change can subsequently be quantified.

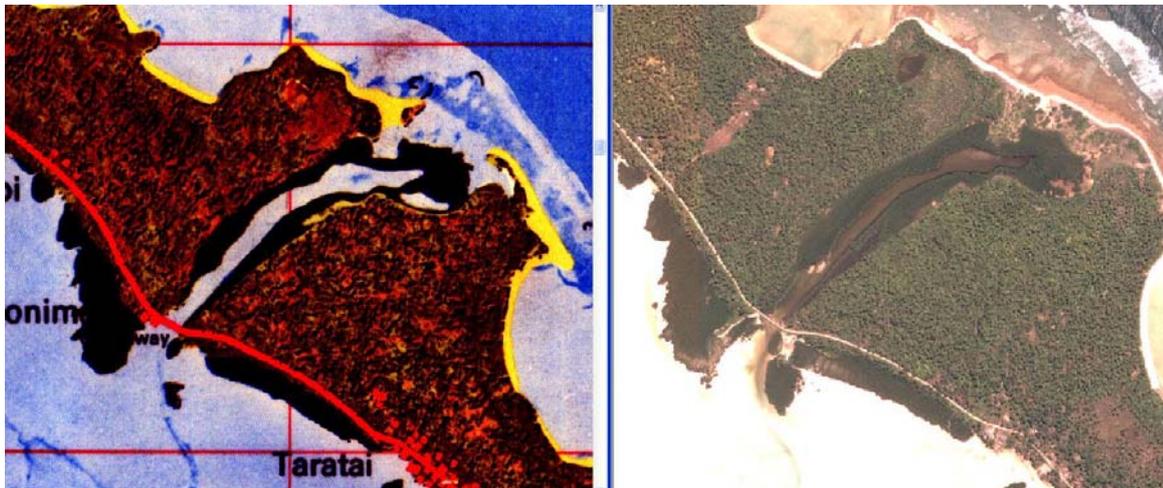


Figure 2: Land cover change in north Tarawa. Left the historical land cover map established from aerial photographs recorded in 1969 and right the recent satellite image showing the actual vegetation cover today. The increase in mangrove area is visible.

historical vegetation map. Then the vector data was rasterised and reduced in resolution to 1 square metre.

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

Results

The land cover change was mapped in the following Kiribati islands: Makin, Butaraitari, Marakei, Tarawa, Maiana, Aranuka, Onotoa, Tamana and Arorae. In eight of nine investigated islands the vegetation (including mangrove cover) seems to have increased; except in Makin where a slight decrease was noted.

GARAEBITI & OTHERS (+ POSTER)

The Oceania Regional Seismic NETWORK (ORSNET) concept

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The Y shape of the Vanuatu islands is a challenge to accurately locate the Vanuatu earthquakes that are occurring along the Vanuatu trench by the local network to improve responsiveness of the Vanuatu Geohazards Observatory as the National Warning Center. Therefore regional cooperation between Vanuatu and New Caledonia is the best solution to this challenge. This regional cooperation is developed by a dual governmental project since January 2011 and through which the earthquake detection system of Vanuatu has been operational since March 2011. This shows how two countries could mutualize resources, equipments and procedures in order to increase their capacity in earthquake monitoring and response to tsunami alert tsunami alert response.

The Vanuatu Meteorology and Geohazards Department and the New Caledonia Institut de Recherche et Developpement (IRD) agreed to share their National Seismic Network through common system and procedures. The use of the same software (Seiscomp3) helps both institutes to share knowledge and tools for earthquake monitoring and automatic detection along the process. Procedures, alert system (email and sms) and information give support for decision makers within these observatories. The first outcome of this regional network is to decrease the earthquake time detection and to help for the dissemination of the early tsunami alert (common and standardized alert system). Moreover this cooperation complies with the ICG/IOC/PTWS recommendations and it shows how better service observatories could bring to their country.

Positive results of this cooperation and the challenges that all Pacific Island Countries are facing with earthquake and tsunami threats force to consider the potential to extend to a larger network between several countries amongst south west pacific area. The Fiji-Tonga network, the Solomon Islands, PNG and Samoa network could all be integrated within a virtual regional seismic network, sharing data regionally and helping locally decision makers regarding tsunami and earthquake threats. The Oceania Regional seismic NETWORK (ORSNET) concept, coming from the New Caledonia-Vanuatu collaboration, is aimed to bring a solution to this regional need.

GARTON & OTHERS

Distant events may dramatically perturb atoll lagoon systems

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A multi-year study of the lagoon system at Palmyra Atoll revealed water stratification in the absence of a strong pycnocline (Gardner et al. 2011). Surface waters are oxygen-saturated but bottom waters are sulphidic and anoxic, with high H₂S and elevated ammonia, and decreased pH,

temperature and chlorophyll a. The persistence of this stratification in such a shallow system (maximum depth 52 m) with no pronounced density barrier was hypothesized to result from the dominant wind-driven westward water flow restricted to the upper water column and facilitated by a dredged ship channel at the west end of the atoll. During late summer 2011, large swells originating from a particularly large storm centre in the Southern Ocean passed across the atoll. The elevated water levels altered the dynamics of tidal exchanges, forcing denser ocean water into the lagoons and fully oxygenating the water column. Nine months later (June 2012) density measurements indicated that stratification typical of the lagoon system prior to summer 2011 was becoming re-established and oxygen levels at depth had declined from ~100% to 50-60% saturation. By August 2012 oxygen saturation had declined to near zero in the deeper basins of the lagoon system and density profiles were similar to pre-storm conditions. These observations confirm that in the absence of a strong pycnocline atoll lagoon systems are vulnerable to storm-driven "turnover" events on perhaps decadal scales, with "recovery times" on the order of one year. Short-term release of bottom water from the lagoon basins onto surrounding coral reef systems is occurring episodically at Palmyra, but the significance of negative impacts, if any, remains unknown.

Reference:

Gardner, J.P.A., Garton, D.W., Collen, J.D. 2011. Near-surface mixing and pronounced deep-water stratification in a compartmentalised, human-disturbed atoll lagoon system. *Coral Reefs*, 30: 271–282.

HOULBRÈQUE & OTHERS

How are major coral species of New Caledonia going to face climate change?

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Coral reefs represent real oases for sheltering about one third of the identified fishes, and representing a major advantage for the economy and tourism of many tropical countries. Among coral reef ecosystems, the lagoon of New Caledonia, which is the second largest in the world, has great species diversity with a high level of endemic species. In the last decade, coral reefs have continued to deteriorate as a result of human influences. The consensus estimates that by the end of the century, calcification rates of the scleractinian corals, which are the major reef builders, will decrease by 17-37% as a result of reduced [CO₃²⁻], due to the increase of atmospheric partial pressure of pCO₂. Several patterns on the effects of climate change have already been determined for some coral species but physiological consequences are still relatively speculative. In our study, we investigated the effects of ocean acidification on photosynthesis, calcification and zinc incorporation of one major species of New Caledonian corals: *Stylophora pistillata*. Colonies of this species were maintained at normal pHT (8.1) and at two low-pH conditions (7.8 and 7.5) for five weeks. Corals were exposed to ⁶⁵Zn dissolved in seawater to assess uptake rates. Zn was taken less efficiently by corals at reduced pH, leading to potential effects on specific coral physiological functions. However following five weeks of incubation under reduced pHT conditions, all coral fragments survived and showed positive gross calcification rates. While it is estimated that most of the tropical corals will reduce their calcification, the

species *S. pistillata*, which represents a major builder of corals reefs in the Pacific, represents one more piece of evidence that some corals can continue to calcify under extremely low [CO₃²⁻].

IRVINE & OTHERS

An Innovative Greywater Treatment Scheme Applicable for Pacific Island Communities

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Isolated geographical land masses such as the Hawaiian Islands and Taiwan have a documented history of water as not only a resource of the community but for a healthy ecology. Supplying sufficient, usable water to consumers is a major challenge for an expanding island population. Sustained pressures on water supply will have an impact with implications to economy and resources [1,2]. A key challenge to tackle water availability at a community level is to design, develop and implement innovative technological approaches to restore impaired waters to a usable state. There is a growing interest for the potential to re-examine closing the loop in the water cycle and re-use greywater [3, 4]. Greywater comes from daily human water consumption/ discharge devoid of fecal material and toilet water [5]. Limited experimental work has been done in the treatment and re-use of synthetic greywater [6]. This seven-week international collaborative study evaluated a two-staged process combining: Entrapped Mixed Microbial Cell Technology (EMMC) in series with a submerged microfiltration membrane (**Figure 1**). Three treatment schemes were evaluated: (**Treatment scheme 1**) Evaluate EMMC process performance for greywater quality enhancement; (**Treatment Scheme 2**) Evaluate membrane process performance for greywater quality enhancement; (**Treatment Scheme 3**) Evaluate combined EMMC/Membrane process performance for water quality enhancement. *Synthetic greywater* was prepared daily and fed in order to better control influent strength and measure treatment effectiveness [6]. Results were analyzed to demonstrate the potential applicability of these technologies for greywater treatment/re-use. It was observed that the using Only EMMC that over 90% organics removal was achieved. No Ammonia-nitrogen removal was observed. Tests using Membrane only demonstrated over 88% organics removal but no significant ammonia-nitrogen removal was observed. The combined EMMC/Membrane process showed an effective organics removal of >90% for the entire process. There is no archipelago-wide program in the Hawaiian Islands or Taiwan for water recycling aside from limited city and county level programs between agriculture, industry, and the water recycling distributor [7, 8]. This work was an International collaboration intended to test the utility and demonstrate the potential reuse capabilities of the proposed combined process for EMMC-Membrane Filtration greywater treatment scheme. Further research is needed at a greater scale. This work expands upon existing knowledge on greywater treatment and re-use. Deliberate initiatives and actions to recapture various wastewater types such as greywater for alternative usages aside direct disposal is certainly a potential water resource that could be tapped into and transformed.

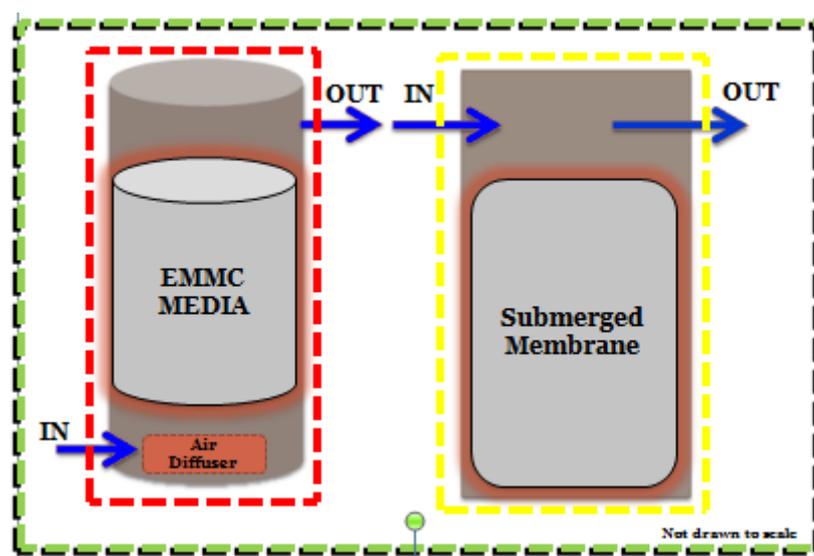


Figure 1. Schematic of proposed two-stage in series greywater treatment system. Treatment Scheme 1: evaluate process performance of EMMC only (red box), Treatment Scheme 2: evaluate process performance of membrane (yellow box), Treatment Scheme 3: EMMC/Membrane in series (green box).

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KASHINO & OTHERS

Ocean observations in the western equatorial Pacific – Triangle trans-ocean buoy network (TRITON) buoys

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Japan Agency for Marine-Earth Science and Technology (JAMSTEC) has conducted ocean observations in the western equatorial Pacific since 1987 for contribution of understanding the Tropical Ocean Climate in the Pacific, focusing El Nino Phenomena. We have been also deploying the Triangle trans-ocean buoy network (TRITON) buoys in this area collaborating with USA and Indonesia since 1998. This buoy network is used not only for scientific research but also for monitoring El Nino/La Nina phenomena and weather forecast. Because of these observations, we obtained some interesting and important scientific results. We would like to introduce TRITON buoys and results from these buoys in this meeting.

In July – August 2012, we conducted the latest ocean observation cruise using R/V Mirai, MR12-03, maintaining the TRITON buoys along 147E and 156E lines. We also deployed two subsurface moorings for observation of the coastal currents near the New Ireland in order to contribute to SPICE (Southwest Pacific ocean circulation and climate experiment) project. We would also like to show the results during this cruise.



R/V Mirai and TRITON buoy at 5S, 156E during MR12-03 cruise.

KRÜGER

Mapping shoreline change and setback options, Lifuka, Ha'apai, Tonga

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On 3 May 2006 Tonga experienced an earthquake of Mw 7.9. GPS data collected around this time shows subsidence of about 227 mm at Lifuka, Ha'apai. Lifuka has experienced significant coastal erosion since this time, with risks to critical infrastructure such as the hospital and communications tower. A historical shoreline change analysis was undertaken using historical aerial photographs, satellite imagery and a digital orthophoto mosaic spanning the period from 1968 to 2011. Weighted linear regression shows maximum annual erosion rates of 1.4 and 0.5 m/year for the southwest and northwest coastlines, respectively. Maximum erosion rates were determined to occur to the south of the Harbour at Pangai and Hihifo, an area experiencing chronic erosion. The construction of a causeway jetty in 1982 and the present Pangai Harbour in the early 1990s may have interrupted longshore sediment transport, in part contributing to the shoreline retreat. Using a one hundred year planning horizon, coastal setback zones of 140m and 50m are proposed for the southwest and northwest shorelines, respectively. These zones are further subdivided into four separate risk zones to aid a staggered approach to the implementation of a managed retreat. An alternative adaptation option using hard structures such as seawalls and revetments is also considered.

KUCHINKE & LENTON

Ocean acidification and ENSO: Decadal trends in the western equatorial Pacific sea surface aragonite saturation state

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The net uptake of carbon dioxide (CO₂) by surface waters that results from increasing atmospheric CO₂ levels is causing the acidity level of the surface ocean to increase. The acidification of the ocean causes a decline in the aragonite saturation state (Ω_{ar}) of surface waters. Values of Ω_{ar} in seawater are often used to estimate net calcification rates in corals. The changes in Ω_{ar} have the potential to affect the ability of coral reef ecosystems, including those of Pacific Island nations, to calcify.

We synthesised available observations from the western equatorial Pacific region to determine the drivers of the variability of carbon system parameters (total dissolved inorganic CO₂ (TCO₂), total alkalinity (TA), pH, and Ω_{ar}). Here, we present the decadal trends of the carbon system parameters under the different ENSO conditions.

On decadal time scales, values of Ω_{ar} across the Pacific show a general decrease in time, due to CO₂ uptake from the atmosphere. A small inter-annual variability in Ω_{ar} is superimposed on the decadal-scale decrease for most regions except the Niño3.4 region (170°W:120°W, 4°S:4°N). Here, inter-annual changes in Ω_{ar} were found to be related to ENSO conditions. Higher values of Ω_{ar} occur during El Niño events and lower values of Ω_{ar} tend to be associated with La Niña events. Under El Niño conditions, the eastward expansion of the West Pacific Warm Pool (WPWP) water (with a lower TCO₂:TA ratio) can lead to surface waters with higher Ω_{ar} values.

KUMAR & KUMAR

Tracking of tropical cyclonic storms and thunderstorms in the South Pacific region – Application of World-Wide Lightning Location Network

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The cyclonic storms are associated with strong winds, rainfall, and thunderstorms generating strong lightning discharges. Lightning measurements have been extensively utilized by meteorological offices as well as by other the scientific community for forecasting of potential threats of forest fires etc due to lightening. Tracking of thunderstorms and rapid intensification of cyclones are also important challenges in weather forecasting in order to warn the potential threats to the communities and thus minimizing the loss of life due to devastating winds and surges associated with cyclones. World-Wide Lightning Location Network (WWLLN) coordinated by University of Washington in USA, of which USP is one of the host organizations among 40 other universities and institutes across the world, gives the real time movement of cyclonic storms and associated lightning events (<http://webflash.ess.washington.edu>). In this presentation, the movement of some of the past and recent tropical cyclones in the South Pacific region and associated lightning activity in the eyewall and the rain bands will be presented to

demonstrate the potential of WWLLN data in timely forecasting of thunderstorms associated with cyclonic storms and thus reducing the overall threat to the Pacific societies.

LAMARCHE & OTHERS (POSTER)

Post tsunami survey, paleotsunami record and numerical tsunami modelling in Wallis and Futuna, South West Pacific

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Wallis and Futuna, between Samoa and Fiji, are two inhabited small islands 260 km apart. Wallis is an intra-plate low lying edifice surrounded by lagoon whereas Futuna is a high island emerging along the northeastern segment of the active North Fiji Fracture Zone. To understand the hazard associated with tsunami generated locally, regionally and across the Pacific, we undertook 1) a survey of the impact of the 2009 Samoan Tsunami on Futuna, 650 km to the west of the epicentre. The maximum run-up heights and inundation distances measured were 4.5 m and 85 m respectively, from 41 sites surveyed. 2) Paleotsunami surveys through logging of coastal trenches and interviews of population. This showed two events in historical and paleohistorical times in Futuna, one of which is dated to around 1480 AD and corresponds with an event related in the oral tradition, the other is dated to 1860-2000 BP. The history of paleotsunamis in Uvea is less well known, but a lack of historical events suggest a lesser risk. 3) Numerical tsunami inundation models for a number of local, regional and distant tsunami using Gerris hydrodynamic solver. Models were run for selected events from around the Pacific. The results indicate sources that are the most likely to affect Wallis or Futuna, e.g. faults along the Chile/Peru coast or along the northern Tonga Trench. The predictions were validated against sea level data from recent tsunami events from Dart Buoys and tide gauges and compared against the records of the 2009 Samoan and paleo-tsunami, to ensure that predictions lie within the expected range of past events.

LEBELLEGARD (+POSTER)

New Caledonia and Vanuatu joint seismic networks and associated early warning system: towards a regional center for tsunami risk mitigation

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NC seismic network development started in 2009, funded by the European Commission. Seismic station construction/instrumentation started in 2010 and the NC network is now fully operational. It is composed of 7 broadband sensors (+accelerometer), in addition with 2 Geoscope stations in NC, all of them connected in real-time to IRD centre of Nouméa. NC network is sharing its data, experience, and procedures with VMGD (Vanuatu seismic network). Data management is achieved using SeisComp3, both in NC & Vanuatu, and plans are to use the same system in other

Pacific island countries, as discussed during SeisComp3 workshop of July 2010 in Suva. A total number of 15 stations are now spread over the very active New Hebrides subduction zone.

Depending on earthquake epicenter location, an alert is transmitted via email and/or SMS to relevant authorities in a delay between 3.5 minutes (Vanuatu EQs), to 6 minutes (Fiji or PNG EQs), up to not more than 10 minutes (distant earthquakes, like e. g. Japan ones). Emphasis will be put on current bilateral cooperation between NC and Vanuatu, and moreover on future plans for extending such cooperation to other Pacific island countries using ORSNET concept. ORSNET achievement should lead to a regional tsunami warning center.

Le réseau sismique conjoint de Nouvelle-Calédonie et Vanuatu et le dispositif d'alerte précoce associé: vers un centre régional d'alerte tsunami

Grâce à un financement de la Commission Européenne, le réseau sismique de Nouvelle-Calédonie s'est développé à partir de 2009, les premières stations commençant à être installées en 2010. Le réseau de NC est désormais totalement opérationnel; il est composé de 7 capteurs large bande (+accéléromètres) relié en temps réel au centre IRD de Nouméa, auquel il convient d'ajouter les deux stations Géoscope de NC. Nous partageons nos données, expérience et procédures avec le réseau de Vanuatu du VMGD. Aussi bien en NC qu'au Vanuatu, la gestion des données est effectuée avec SeisComp3, et il est envisagé d'utiliser le même système dans les autres pays insulaires de la région, comme discuté lors du meeting SeisComp3 de juillet 2010 à Suva. Au total, ce sont désormais 15 stations temps réel qui recouvrent la très active zone de subduction des Nouvelles Hébrides.

Selon la localisation de l'épicentre, une alerte est générée et transmise aux autorités compétentes dans un délai compris entre 3 minutes et demie (séismes de Vanuatu), 6 minutes (séismes de Fidji, PNG), jusqu'à un maximum d'une dizaine de minutes pour les séismes plus lointains comme les séismes japonais. L'accent sera mis sur la coopération bilatérale entre la NC et Vanuatu, et surtout sur les perspectives d'étendre cette coopération aux autres pays de la région à travers le concept ORSNET devant mener à un centre régional d'alerte tsunami.

----- LEFÈVRE & OTHERS

Transport of volcanic gases from Vanuatu and implications

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On average, SO₂ emission from Ambrym (Vanuatu) may be equivalent to at least 50% of anthropogenic SO₂ emissions from Australia, the largest and closest continent. Yet during periods of extreme degassing, the volcanic gas emission can exceed the anthropogenic SO₂ budget from the whole of Oceania. In steady conditions, passive degassing from Ambrym injects 5.4 Ktons(SO₂).d⁻¹ directly in the cloud boundary layer, which in turn is oxidized in the gas and aqueous phase to form sulfate aerosols after a life time of 20 hours. By combining remote sensed observations (OMI, MODIS, CALIPSO) and modelling using WRF-Chem coupled to the GOCART aerosol model, we show that this injection of sulfate aerosols takes place in a clean marine (sea-salt dominated) environment. We also show that trade winds drive the low-level transport and

deposition of sulfur material emitted from Vanuatu down to Papua-New Guinea, while the SPCZ convection controls the upper-level long-range transport toward the Central Pacific.

Using pH rainfall measurements during the 2012 Pandora sea-experiment, we report pH anomalies downwind of Ambrym, Bagana (Bougainville) and Rabaul (New-Britain), coherent with simulation of SO₂ plume transport and dispersion of volcanic emissions. These results and others reported acid rain events in the North tip of New-Caledonia support the fact that volcanic species from distant sources may impact the air composition of some Pacific islands remotely.

Some important scientific questions are emerging on the radiative effects of sulfate on the regional climate as well as the role of volcanic ash onto the ocean fertilisation. In that context, we present our ongoing effort to understand these regional climate and ecosystem effects, within the framework of a joint French-USA-Vanuatu Research program focused on the influence of ash deposition to marine production in Vanuatu coastal waters.

LESIMPLE & OTHERS (POSTER)

Natural asbestos in peridotite nappe: a trial of typology and fibrogenesis comprehension.

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Asbestos is a mineral substance naturally occurring in some type of rocks. Beyond its industrial use, asbestos represents a significant environmental risk when human beings are located in or near geological formations possibly containing asbestos minerals.

This is the case in New Caledonia and particularly in an important lithology, as well for its economic value than for its surface: the peridotites. It represents 1/3 (a third) of the territory and is the host of nickel ore, the first resource of the island.

Understanding the fibrogenesis process during the geological history of the subducted peridotite nappe is essential in order to consider the risk and improve prevention methods.

The data acquired in a first tile allowed recognising different asbestos mineral species present in the ultrabasic rocks of New Caledonia: chrysotile and antigorite for the serpentines and tremolite and anthophyllite for amphiboles. Those minerals are ubiquitous and frequently associated in tectonic structures:

- A fine serpentine network, anostomosed, developed at the expense of peridotite (pseudomorphic texture) containing veinlets more or less continuous of chrysotile.
- Opened structures with crystallization of fibrolamellar antigorite presenting signs of movement and with serpentised borders containing chrysotile.
- Amphibole crystallizations in border of Eocene dykes (gabbros, diorite, ...) crosscutting peridotites.
- Crystallizations of tremolite in veins from less than 1mm to several cm crosscutting peridotites.

Coupled with isotopic and geochemical analysis, those observations allowed to establish a clear typology of asbestos occurrences in peridotite nappe, and to link them to the different geological events that affected this geological formation, from oceanic expansion to obduction and weathering.

McADOO

Tsunami Risk: Lessons learnt from Samoa, the Solomon Islands, and other recent disasters

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The tsunami that devastated the Solomon Islands in 2007 and Samoa and Tonga in 2009 highlight the need to explore the interdisciplinary nature of risk beyond the detailed understanding of the mechanics of the earthquakes and propagation of the ensuing waves. While the physics of these hazards provide the foundation for understanding the risk, continued efforts must be made in understanding the vulnerabilities of associated ecosystems and the communities that rely on them for their survival. And where tsunamis are unarguably dramatic and devastating events, the weaknesses in the system that they expose can provide critical data that can be used to prepare for the next inevitable events including rapid-onset tropical cyclones and slow-onset sea-level rise.

Risk occurs at the intersection of hazards and vulnerability. In the case of geohazards, it is the job of the geoscientists (geologists, seismologists, atmospheric scientists) to provide the physical basis of the hazard, as well as the critical information regarding frequency and magnitude of occurrence. To address the ultimate goal of Disaster Risk Reduction (DRR), the geoscientists must engage the ecologists and social scientists that understand the vulnerabilities of the systems exposed to the hazard. Following the 2007 Solomon Islands earthquake and tsunami, hundreds of kilometers of coastline was uplifted, exposing and killing the reef offshore. This not only will have long-lasting effects on fisheries, but also inhibited delivery of aid and transportation in the region. In Samoa, following the 2009 earthquake and tsunami there, the coastline wasn't uplifted, but damage to the fisheries resulted in a drop in catch during the time following the disaster. This not only affects local fishermen's livelihoods, but potentially food security, making them more vulnerable to future storms. And developing nations in the Pacific are not alone in this- the Japanese fishing industry has been devastated by the 2011 tsunami and meltdown at the Fukushima-Daiichi nuclear power plant.

Reconstruction from these events as well as preparation for the next events must be informed by these researchers working in concert toward the ultimate goal of DRR. Geologists must look to see how often, and ideally how big, hazards have occurred over the last 10,000 years. Once this is determined, they need to communicate with planners to determine what mitigation efforts should be considered. Do they move people out of the coastal zone, compromising their livelihoods and cultural roots? Or, do they set in place evacuation plans and or structures so that economies and societies are not compromised? Should the billions of dollars dedicated to reconstructing Haiti be used to provide infrastructure for Port-au-Prince, or should it be used to encourage investments in the countryside? Without this deliberate conversation, mistakes will be made, people may die, and potentially millions of dollars will be wasted.

MENKES & OTHERS

The South Pacific Convergence Zone: present and future

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The SPCZ (South Pacific Convergence Zone) is the largest and most persistent convective area of the southern hemisphere. It determines the climate of many of the South Pacific Island countries. The recent CLIVAR panel meeting (CLImate VARIability and Predictability, Nouméa, April, 2012) has pointed out that this key region for the world climate is still poorly documented and its functioning is largely unknown. The SPCZ varies at multiple scales and controls 15% of the annual cyclogenesis. In this contribution, we review the present knowledge of the SPCZ dynamics and its controls onto cyclogenesis, as well as its interannual variability linked to ENSO (El Niño/Southern Oscillation). One particular mode of the SPCZ variability is a mode where the SPCZ becomes zonal and extends to the eastern Pacific with tropical cyclones hitting down to French Polynesia. We further describe the current knowledge about the SPCZ evolution with climate change as seen from the CMIP3 and CMIP5 climate models and what is projected for the tropical cyclones evolution from both climate models and regional downscaling. We finish our contribution by describing how the zonal mode of the SPCZ is likely to increase in the future, which may lead to an increase of extreme impacts such as cyclones in regions otherwise spared.

POWER & OTHERS

Developing a national tsunami hazard model for New Zealand

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Effective mitigation of the risks posed by tsunami is an urgent priority for New Zealand, a South Pacific country straddling the 'Ring of Fire' and its associated subduction zones. Ways to mitigate the risks are in various stages of development, these include: evacuation mapping, land use planning, and engineering of tsunami resilient buildings and infrastructure. But for this mitigation to be effective an accurate estimate of the hazard posed by tsunami is needed. This is the motivation behind the creation of a national probabilistic tsunami hazard model.

The model considers all types of seismic tsunami sources, whether local, regional or distant to New Zealand; and has the potential for including other kinds of tsunami source, such as landslides and volcanoes. A critical issue when defining tsunami sources for New Zealand is that the magnitude-frequency distributions are often not accurately known. This is because the historical record of large earthquakes and tsunami in New Zealand is too short, and the paleotsunami record is incomplete. Fortunately some of the parameters that determine the magnitude-frequency distributions can still be estimated, albeit with uncertainty. We present a

Monte-Carlo method for estimating the tsunami hazard which can take these uncertainties into account.

Our method requires the generation of many synthetic catalogues, and uses techniques for quickly-calculating estimates of the tsunami heights in each scenario. The results can be presented as hazard curves, describing tsunami height as a function of return period for short sections of coast; these hazard curves include 'error bars' as determined from the uncertainties.

Practical mitigation measures require inundation modelling, as well as estimates of the hazard at the coast, and for this purpose we propose to use 'de-aggregation'. This results in a small set of scenarios to be used for the purposes of detailed inundation modelling.

ROUILLARD & OTHERS

The Tasman Frontier Database: a regional collaboration to promote geosciences research and natural resources in the South-West Pacific

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The Tasman Frontier region is a giant submerged continental fragment of over 3,000,000 sq km between Australia, New Zealand and New Caledonia, which formed with the final break up of eastern Gondwana about 85 Ma ago. It hosts a number of unexplored sedimentary basins, some of which may share a common geological origin with the Taranaki and Gippsland basins, where petroleum production is established.

In 2009, GNS Science, Geoscience Australia, Service Géologique de Nouvelle-Calédonie (SGNC-DIMENC), ZoNéCo research program (ADECAL), and Institut français de recherche pour l'exploitation de la mer (IFREMER) engaged a collaborative initiative to compile all publicly available seismic reflection data from the region in a unique database.

This database was released in March 2012 and contains c. 100,000 line km of digital seismic data that have been modified into a uniformed seg-y format. This product not only gives the opportunity to promote the exploration of natural resources of the Australia, New Zealand and New Caledonia EEZ, but provides a common baseline data set for geoscientists across the three jurisdictions and a regional-scale perspective for future research.

SÉRINO & OTHERS (POSTER)

Peridotitic sinkholes (dolines) of New Caledonia

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New Caledonia presents one of the most extensive outcrop of ultrabasic rocks which host nearly 30% of the world's nickel reserves. At the outcrop, these peridotites present a karstic landscape resulting from weathering and fractures by dissolution. Olivine is the main constituent of peridotite and is an unstable mineral, enlarged which is prone to dissolution in tropical climate. One of the most extensive karstic features of New Caledonia is a network of sinkholes, which correspond to temporary or permanent ponds. The question of the existence and characteristic of an underground karstic drainage system in the peridotites still remains as an open question and the sinkholes might constitute a way to probe this karstic system. Moreover, the sinkholes constitute a specific environment for vegetation and aquatic life. Our project is funded by CNRT Nickel and its Technology as part of the "Sinkholes typology" call. It is designed to characterize the sinkholes of New Caledonia from their geological, hydrological and biological properties. As part of this study an automatic detection procedure was setup from available remote sensing data (orthophotographs, DEM, Lidar). The Lidar data have proved to be very efficient in detecting both the shape of the sinkholes and their topography. Different detection methods will be illustrated with emphasis on their complementary properties. Finally, a tentative of preliminary classification of the sinkholes based on remote sensing and field studies is proposed.

SUETSUGU & OTHERS

Recent and future geophysical observation for origin of the Ontong Java Plateau

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The Ontong Java Plateau (OJP), in the western equatorial Pacific Ocean, is one of the largest oceanic plateaus on Earth, covering 1.86 million square kilometers - equivalent to roughly one third of the contiguous United States (e.g., Coffin and Eldholm, 1994). This voluminous plateau is thought to have formed about 120 million years ago and to have caused significant global environmental changes; however, a consensus has not been reached on why and how the OJP formed.

To investigate the OJP's crustal structure, an active source seismic experiment was conducted in 2010 with R/V KAIREI of JAMSTEC on the central OJP using a multi-channel seismic (MCS) profiler (Miura et al., 2011) and 100 ocean bottom seismographs. Although the analysis is still ongoing, we tentatively determine the thickness of the OJP crust to be 35-40 km beneath the central part of the OJP. The lower crustal body is about 16-km thick.

During the cruise, seamounts with little sediments were discovered, suggesting that volcanic activity occurred at relatively recent time after the major OJP eruption. In August of 2012, we

conducted a dredge cruise to take rock samples from the seamounts with R/V MIRAI of JAMSTEC. We have just started mineralogical and geochemical analyses of the samples, which may provide another important information on the OJP formation.

We have a plan to conduct seafloor geophysical observation for mantle structure from 2014 to 2016 with broadband ocean bottom seismograph (BBOBS) and ocean bottom electro-magnetometers (OBEM). Previous studies using data from seismic stations on oceanic islands showed that the OJP has a slow velocity root down to 300 km, of which the origin remains to be resolved (thermal or chemical anomalies). The new dense seafloor observation will improve the accuracy of the seismic image of the OJP root significantly.

TALIA

Samoa Seismic Network

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The Samoa Islands chain is located just north of the seismically active Tonga Trench. There have been around 30 quakes of magnitude 7.0 or more along this trench since 1900; (<http://earthquake.usgs.gov/regional/neic>). Several records of past tsunamis have been identified and documented which have reached the Samoan Islands. These events have not only originated from the Tonga trench but also as far as Chile, Peru, Japan and around the globe. The consequences have impacted the lives of the Samoan people through the years. The most recent tsunami happened on the 29th of September 2009 at 6:48 in the morning. This is the wakeup call for not only the government of Samoa but also countries of the Pacific. 191 lives were lost in Samoa, American Samoa and Tonga, with costs to property and infrastructure exceeding USD200 million in Samoa alone, people and homes were relocated and hundreds were traumatized. Such natural disaster event prompted the Samoan Government to seek assistance from overseas partners to improve warnings to the public in a timely manner. Samoa is now building 3 broadband and 3 short period seismic stations and a national data center as part of the Samoa China Seismic Network project. The whole Samoa Seismic Network comprises of seven seismic recording seismic stations and a national data center. The existing broadband station (AFI) is a USGS funded station which had been operational since 1981.

TAWAKE

An update on the implementation of the regional SPC-EU Deep Sea Minerals Project

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The year 2012 is only the second year in which the regional SPC-EU EDF10 Deep Sea Minerals (DSM) Project has been implemented in the fifteen Pacific ACP States. A lot had been achieved in the last 20 months including a number of milestones. With the urgent need to visit participating countries of the Project and hold national deep sea minerals stakeholder consultation workshop, significant amount of time and effort were dedicated to country visits and in-country stakeholder consultations in the last year.

A notable milestone is the development, review and completion of the “Pacific ACP States Regional Legislative and Regulatory Framework for Deep Sea Minerals Exploration and Exploitation” that was officially launched during the Forum Leaders meeting in Rarotonga Cook Islands in August 2012. Further, ongoing discussions are progressing well with a number of participating countries on how the DSM Project will assist them in developing their national seabed minerals policy, legislation and regulations. Tonga is the first country to be assisted by the DSM Project in the drafting of its national Seabed Minerals Bill and Regulations in consultation with the Tonga Crown Law Office.

In regards to capacity building initiatives of the DSM Project, a legal internship scheme was introduced in January of 2012 whereby law graduates are contracted on short-term basis to assist the DSM Project Legal Advisor and be trained on legal aspects of deep sea minerals. Secondly, discussions are well underway with a number of participating countries on a collaborative effort for the DSM Project to provide funding support that will enable identified candidates to participate in shipboard surveys as well as post-survey data processing and report writing. Additionally, a number of deep seabed minerals related regional training workshops have been scheduled for the next two years with the purpose of developing or enhancing the trainees’ knowledge on specific aspects of deep seabed minerals.

The Project has been sharing relevant deep sea minerals information through progress reports, information brochures and media releases with Pacific ACP States and other interest groups. This presentation highlights the progress being made on the implementation of the DSM Project as well as some of the challenges encountered in the last 20 months.

THIERRY & OTHERS (+POSTER)

Oceanologic monitoring of the Wallis islands in the global climate change

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An oceanic monitoring of the Wallis & Futuna islands have been undertaken, starting in November 2005, as part of the assessment of the impact of global warming and following the guidelines of the French Ministry of Sustainable Development through organizations such as IFRECOR, ONERC MEDAT. This survey is made by the Service de l’Environnement de Wallis & Futuna and by the University of New Caledonia.

To estimate the climate warming impact on islands inside the coral reef area and of sea shore modifications, protocols have been defined and some indicators have been chosen by the governmental institutions such as:

- mean temperature of sea water, near the barrier reef and in the lagoon,
- atmospheric mean temperatures,
- mean sea level variations,
- sea water salinity variations,
- exposure of population to sea hazard ... etc

This survey began in Wallis and Futuna in November 2005 and lead to the creation of a large environmental database from the recordings of seawater temperature, sea level, tides, waves height and period, directional waves spectra and sea currents from immersed tide and waves gauges SBE26 and Acoustic Doppler Current Profiler, Nortek 600 kHz. Data are retrieved every

three or four month and an examination of data is made for each session to characterize environments and to follow their evolution through time.

These recordings are completed and compared with those from other public institutions as **Meteo France** [www.meteo.nc] for the weather data, **SHOM** for tide forecast, **IFREMER**, **Iowaga Server** for oceanic weather and waves forecasts, **Mercator Ocean** for [www.mercator-ocean.fr/fre/] sea surface temperature, **CNES Aviso Oceanobs** [www.aviso.oceanobs.com] for sea level variations from radar satellite observations. Ocean Currents Analysis [www.oscar.noaa.gov].

Selected places have been defined around the islands to measure morphological changes linked to the sea level rise throughout time. An inspection of the coastal zone is carried out regularly to report any shoreline erosion. The impact of human activities related to the customs of the inhabitants is estimated from sociological surveys All data are reported on some websites <http://pages.univ-nc.nc/~hoibian/Tomas/tomas.html> for the hurricane impact, and <http://servlet.univ-nc.nc/series/ifrecor/index> for all reports of the surveys around the world.

WHITE

Lumped characteristics of rainfall harvesting in the Central Pacific

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Central Pacific Island Nations have relatively high mean annual rainfalls. Because of this, rainfall harvesting and storage is an important supplementary source of potable water for island households. A simple dimensional analysis of the monthly rainwater catchment water balance reveals that there are only two key lumped parameters for rainwater systems the reduced effective roof area \bar{A} (month/m) $\bar{A} = C \cdot A/M_t$ where C is the roof catchment runoff coefficient (dimensionless), which incorporates all losses relative to rainfall and M_t (KL/month) is the total household (or water supply system) monthly demand and the reduced rain tank storage capacity \bar{S} (month) $\bar{S} = S/M_t$, where S is the tank capacity (KL). The relative magnitude of these two parameters coupled to the local monthly rainfall record determines the risk of failure of the rainwater storage system. The use of this simple system is illustrated using rainfalls from islands spanning the central Pacific. Fluctuations in sea surface temperatures there lead to high rainfall variability. This variability coupled to the characteristics of household storages in the Central Pacific, small roof areas and tank volumes and large number of people per household, means that there are large risks of storage failure. The simple monthly model is in quite reasonable agreement with a more accurate daily model. Strategies for lessening the risks are considered.

WHITE & OTHERS

Vulnerability of groundwater resources in Tongatapu

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Two thirds of the population of the Kingdom of Tonga live on the small, South Pacific raised limestone island of Tongatapu. Almost half Tongatapu's population live in the capital Nuku'alofa. Groundwater is the principle source of reticulated fresh water both in Nuku'alofa and in rural villages and is sourced from a relatively thin, fresh groundwater lens overlying seawater. This paper describes a comprehensive, integrated assessment of the vulnerability of fresh groundwater in Tongatapu. Water resources policy and legislation, and the organisation structures for regulating and managing of water were examined. Threats to groundwater from seawater intrusion, overpumping, agriculture, waste disposal, industry, quarrying, urban settlements, population growth, droughts and climate change were analysed using existing data, field measurements and predictions from global circulation models (GCMs). Weak trends in rainfall and in estimated evaporation were at odds with GCM predictions. The impact of pumping on freshwater salinity is clearly discernible within ENSO signatures. Suggestions are made for improving the protection of water resources, mitigating saline water impacts, enhancing freshwater supplies and for reforming regulation and management.

Developing knowledge-based national water policy and implementation plans in Pacific Small Island Countries: a practical response to climate change

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The threats of climate change to Pacific Island Countries (PICs) and especially low-lying islands are well known. First impressions are that adaptation to change is an enormous task for isolated PICs with limited resources. Some have argued that any activity towards ecologically sustainable human development constitutes adaptation and that the only rational adaptation strategy is to develop the general capacity of societies to cope with change by building up its institutional structures and human resources while maintaining and enhancing the integrity of ecosystems. Others have suggested past experiences in coping with climate variability provide good lessons for developing adaptation policy and plans which, when coupled to the natural resilience of island populations, mean that prospects for adaptation are less bleak. Some authors have concluded that the international focus on adaptation to global climate change has distracted PICs from addressing the actual, local sustainability problems facing island communities, particularly in managing vital freshwater resources and ensuring their longer-term security, which is the focus of this paper. Here we describe a five phase adaptive planning process carried out to assist in the development of knowledge-based national water policy and implementation plans in two dissimilar PICs in the Central and Central Western Pacific, which address both immediate and perceived future challenges. These PICs have water resource problems amongst the most challenging in the world. Population centres in small islands, particularly low atolls and higher

carbonate islands, have rapidly growing populations and largely unplanned urbanisation with significant impacts on water quality. In these high-density areas, the traditional coping mechanisms and customary values appear mismatched to growing urban situations. These factors constitute greater risk to water security to the year 2030 than climate change. There is often limited government direction, unclear management and regulatory roles, very few national water laws and limited scientific information on the quantity, quality and variability of water resources and their relation to climate. Because of these, public policies, specifying clear priority goals and objectives with achievable policy implementation plans incorporating acquisition of reliable resource information are necessary. Implementation is therefore a long-term process which requires suitable long-term support both from properly resourced regional organisations, and from aid and donor agencies. This support should focus on the pressing needs and priorities for water security identified by the PICs themselves.

WILES & OTHERS

Climate Variability and Adaptation in Tuvalu

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The 2011 La Niña brought severe drought to the central, equatorial Pacific, particularly in Tuvalu. Signals of the developing La Niña were provided by the ocean and atmosphere observing systems, so predictions were possible for the low rainfall period. To build resilience to these drought events, projects such as The Pacific Adaptation to Climate Change (PACC) are working across the Pacific, including in Tuvalu, to enhance water management (along with food security and coastal zone management).

In late 2011, an increase in the easterly trade winds along the equator and the associated Southern Oscillation Index was observed, along with a decrease of sea surface temperatures along the central equatorial Pacific (i.e. a La Niña event). By monitoring these signals, advance warning can be given of particularly dry (or wet) seasons. The ocean observing system also detected a noticeable increase in the surface mixed layer salinity due to the lack of rainfall.

While it is unclear if the Pacific will experience more or less El Niño or La Niña conditions in the future, adaptation to this type of climate variability is often synonymous with adaptation to climate change. The PACC project is working in Tuvalu to incorporate these climate risks into water policies and plans, and ensure they are linked and well reflected in its national development strategies. An important component of the project is demonstrating adaptation design and implementing hard and/or soft adaptation solutions with the village community at the grass roots level.

WILLIAMS & OTHERS

Towards the development of a palaeotsunami database in the Samoan Islands

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A palaeotsunami investigation on Savai'i and Upolu in the Independent State of Samoa, and on Ta'u in American Samoa, was initiated following the devastating September 29, 2009, South Pacific Tsunami (2009 SPT) in this region. The overarching aim of this investigation was to identify and characterise the 2009 SPT deposits using a suite of multi-proxy criteria (eg. sedimentological, geochemical, geochronological and numerical modelling), and to employ the data as an analogue for identifying similar high-energy wave deposits in the Samoan geologic record. Efforts to distinguish between tsunami and cyclone deposits in these islands were also a project objective.

This presentation discusses the 2009 SPT deposit characteristics on Upolu island, and employs the data as an analogue for identifying similar events within the Samoan geologic record. Preliminary geochronological results indicate that a long-term record of high energy geologic events, be them tsunamis or cyclones, exist in these islands. Further, the results form a basis for the identification of priority sites for more detailed investigation, leading towards the development of a palaeotsunami database for this region. Ultimately, this work provides an avenue for understanding the long-term risk of tsunamis in Samoa, and may also contribute to long-term coastal mitigation strategies in tsunami risk areas.

ZIELINSKI & OTHERS (POSTER)

Probing the magma plumbing of Ambrym volcano (Vanuatu), by a triangular acoustic network

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The acoustic triangular network installed in 2008 on Ambrym volcano has proven to be suitable to monitor the volcanic activity of both Benbow and Marum, the two main active craters of Ambrym volcano with open vent system. More than hundred thousand acoustic events have been recorded within a 4 months period, indicating continuous magmatic events on Ambrym. Both Benbow and Marum have demonstrated the possibility to host strong magmatic activities with huge amount of

gas released. These two active cones are connected to a unique magmatic reservoir with a sloping roof towards Marum. This subsurface configuration is responsible for the successive Strombolian phases that occurred only on Marum. A closer analyses of pre-Strombolian phases have pointed out acoustic parameters that merits further consideration, in the purpose of anticipating Ambrym volcanic activity, including an increase of signals amplitude, the occurrence of low frequency (0.1-0.8 Hz) and long duration signals, associated with increase of gas volume. Continuous acoustic measurements are therefore a new important tool to use to monitor volcanic activity: they can provide real-time estimates of gas volume and pressure, two parameters crucial to know in order to assess the danger for nearby populations.

SOPAC-2/STAR

The SPC Jacques Iakewe Conference Centre

ABSTRACTS OF THE SOPAC DIVISION TECHNICAL PROGRAMME HIGHLIGHTS PRESENTED DURING THE SECOND DIVISION MEETING (see paper SOPAC-2/2.3 for more details)

French Polynesia: Tuamotu Archipelago – Reducing the Risk of Storm Wave and Surge

French Polynesia experiences major natural hazards, some of which are potentially very damaging to infrastructure and the economy. Likewise, such storms can present significant direct threats to human well-being and have resulted in loss of life. In response, French Polynesia has introduced a risk prevention policy including regulations designed to provide a higher level of protection during natural disasters. Such regulations are based on scientific data that is used to assess risk-prone areas however given topographic and bathymetric data and associated modelling of extreme wave/surge impacts have not been widely available in outer island areas such as the Tuamotu Group, improved assessment of such hazards has not been undertaken. The *Supporting Disaster Risk Reduction in Pacific Overseas Countries & Territories* Project is funded under the 9th European Development Fund – C Envelope and is implemented by the SOPAC Division. Under the framework of French Polynesia's national disaster risk prevention policy, this activity seeks to provide an accurate definition of the inundation hazard from tropical cyclone waves in select areas of the Tuamotu archipelago. The results will feed into revised land use and disaster plans, with a view to enhancing community safety and protecting coastal infrastructure. Application of the data also extends to the pearl culture and tourism industry, environmental protection and maritime security. An extensive programme of conducting bathymetric, oceanographic and topographic surveys and data collection in five atolls (Rangiroa, Manihi, Kauehi, Arutua and Apataki) was undertaken during 2011/2012. Efforts are now underway to process and analyse the data to enable the development and testing of cyclone wave models and inundation maps. Final model and products will be completed mid-2013.

Fiji: An Integrated Approach to Water Resources and Flood Management in the Nadi Catchment

The Fiji floods in January and March 2012 reinforced the need for integrated flood management strategies to minimise the impacts of flooding in the affected areas. Government reported damages from the 2009 flood to cost around US\$60 million. The GEF-funded IWRM project at SOPAC Division, together with the Government of Fiji is implementing the establishment of the Nadi Basin Catchment Committee (NBCC) to contribute towards improved flood forecasting and early warning, floodplain zoning and regulations, community awareness, developing ridge to reef catchment guidelines and strengthened institutional capacities and arrangements for water resources and flood management in the Nadi catchment with a view to this being replicated in other catchments where applicable.

Federated States of Micronesia: Construction of Emergency Operations Centres and DRM Training Provided

The European Union funded B Envelope Project has provided support to the Federated States of Micronesia to strengthen early warning system networks and renovate Emergency Operation Centres (EOCs) in each of the four states. The renovation works for the Emergency Operation

Centres in Yap, Kosrae, Chuuk and Pohnpei states have been completed. The construction of a National Emergency Operations Centre in Palikir commenced in January 2012 and is scheduled for completion in November 2012. The early warning communications network will be strengthened with the supply of HF and VHF radios in outer islands of all states with installation to commencing in the last quarter of 2012. The support provided for emergency response coordination through improved physical infrastructure and facilities has been complemented through an ongoing capacity development programme for government officials and other key emergency stakeholders by The Asia Foundation in collaboration with the SOPAC Division. Approximately 170 personnel have been trained in a range of courses including Introduction to Disaster Management, Initial Damage Assessment, Emergency Operations Centres and Exercise Management.

Solomon Islands: Institutionalisation of Disaster Risk Management Training

Building on the successful partnership between the Solomon Islands College of Higher Education (SICHE), the Solomon Islands National Disaster Management Office (NDMO), The Asia Foundation and SPC/SOPAC a four-day version of the Introduction to Disaster Management (IDM) and Initial Damage Assessment (IDA) training courses was developed for delivery to post-secondary training institutions in the Solomon Islands, focusing primarily on nursing schools. The combined course was delivered to students at SICHE in April 2012 and again to students at nursing colleges at the Atoifi Hospital in August 2012 and Munda Hospital in September 2012. In 2012 a total of 117 nursing students have completed this disaster management training. Significant these trainings were delivered by national trainers from the Solomon Islands who have been developed through the Pacific DRM (Training) Program supported by The Asia Foundation in Collaboration with the SOPAC Division.

Tonga: Lifuka Island – an integrated and multi-disciplinary approach to adaptation and coastal threats in the Ha’apai Group

Coastal vulnerability is a key issue in PICTs. Sea-level rise and extreme high water/wave events, which cause erosion, infrastructure damage and salt water incursion into low lying coastal areas are concerns in low-lying islands like Lifuka in the Ha’apai Group, Tonga. Lifuka is presently facing a number of existing and emerging coastal vulnerability issues caused by rapid subsidence. Shoreline erosion and groundwater water resources availability are major concerns in this community. The SOPAC Division have partnered with the Human Development Programme (HDP) to characterise the vulnerability and impacts with a view to developing solutions and appropriate climate change adaptation responses. Funded under the DCCEE (Dept. of Climate Change & Energy Efficiency – Australia), PACCSAP (Pacific Australia Climate Change Science and Adaptation Planning Program) the work recognises the inextricable link between groundwater resources and coastal processes in Pacific Island low-lying environments. SPC, in implementing this project using an integrated and multi-disciplinary approach, recognises the complexity of the issues being faced and added benefits and efficiencies of undertaking such tasks in cross-sectoral partnerships. The hydrological work will provide improved understanding of the present groundwater resources and impacts of rapid sea level rise (subsidence) on the resource. The characterisation of the vulnerability of the shoreline to erosion and potential inundation will lead to improved information for the groundwater vulnerability assessment and infrastructure damage. Empirical guidance will then be shared with the Lifuka community to assist in decision making and discussion of adaptation responses. The HDP is instrumental in this regard as it has collected critical information about the community to assess its adaptation capacity and its understanding of impacts and possible responses.

Cook Islands, Niue, Kiribati, Tokelau, Tuvalu, Nauru and the Marshall Islands: Maritime Boundaries Agreements Signed

As set out in the 1982 United Nations Convention on the Law of the Sea (UNCLOS) to which all PICs are parties, shared boundary treaties along with the declaration of baselines and maritime zones and limits provides the foundation (geospatial framework) for improved governance, protection, conservation and management of marine resources within national jurisdictions. In August 2012, seven PICs signed eight new maritime boundary agreements (Pacific Islands Forum meeting, Cook Islands) bringing state-of-the-art accuracy and legal clarity to the boundary positions of seven overlapping PIC maritime jurisdictions. This brought the number of regional settled shared boundary treaties from 21, to 28 with approximately 20 more as yet undefined.

The Cook Islands, Niue, Kiribati, Tokelau, Tuvalu, Nauru and the Marshall Islands have been working towards this achievement for more than a decade with the assistance of the SOPAC Division and legal/technical partners (Geoscience Australia, the Forum Fisheries Agency, the Commonwealth Secretariat, the Australian Attorney General's Office and UNEP GRID Arundel). Key to this recent success is the current strategic and sustained approach adopted by the SOPAC Division with long-term partner, Geoscience Australia to develop technical solutions in association with island Members. The approach has provided the opportunity to build islands Members' internal maritime boundary capacity (technical and legal) so that each jurisdiction can take full ownership of the process. Through a series of progressive maritime boundaries technical workshops (one approximately every 8 months and the 10th will be held in November) PIC representatives are brought together with considerable technical expertise to progress regional boundaries work.

Given the renewed interest in this work following the August treaties signing it is important for Members considering finalising their treaty arrangements to recognise that a signed treaty is only the 'tip of the iceberg' of work to arrive at that point. The country technical teams, SPC and partners place great emphasis on building the foundations of this work to ensure that boundary solutions are developed which are durable and will service each jurisdiction's interests for the foreseeable future.

Tuvalu, Marshall Islands, Nauru, Tonga and Vanuatu: Ecosanitation Promotion (EcoSan Toilets "on the move")



Tuvalu Falevatie on Truck

The Global Environment Facility (GEF) Pacific Integrated Water Resources Management (IWRM) Project Tuvalu Demonstration activity aims to demonstrate that improved sanitation technology and practices can protect water resources, marine biodiversity, livelihood, food security and public health. The Project embarked on an awareness programme to change people's perceptions about how to best deal with sanitation on atolls and then to demonstrate it practically. After 3 years, a successful public education campaign has resulted in acceptance of the EcoSan toilet (named locally as Falevatie) and the installation of 40 EcoSan toilets in Funafuti. Falevatie's are Tuvaluan designed and have created wide interest in the Pacific, particularly for atolls and can be said to be on "On the Move". The acceptance of this approach is evident in a quote from the Hon. Willy Telavi, Prime Minister of Tuvalu stating that *"the Government is [...] very supportive of the initiative for people to have access to compost toilets, not only on the outer islands but also in the capital, where they can afford to have these compost toilets. So we can reduce the use of water and the adverse impact of waste water to our groundwater table."* The GEF Pacific IWRM Project has been replicating this design in other Pacific Nations; helping construct demonstration EcoSans in Nauru, Marshall Islands, Vanuatu and Tonga.

Nauru: National Policy and Planning Frameworks for Water, Sanitation and Hygiene

Water supply and sanitation issues in Nauru are amongst the most complex and challenging in the world. Frequent and severe droughts, increasing demand for freshwater, and pollution threats to its limited groundwater supply put Nauru in a precarious situation. Added to this is Nauru's reliance on aging infrastructure and energy-intensive desalination; the challenge of securing sustainable funding sources; and coping with the projected impacts of climate change. The Government of Nauru hopes to overcome these issues through applying an integrated approach to managing its scarce water resources. The IWRM approach has now been adopted through Nauru's endorsement of its first National Water and Sanitation Policy developed with the support of SOPAC Division. Nauru's National IWRM Coordinator (Haseldon Buraman) says: *"The scale of the problem and the issues we need to deal with go beyond traditional infrastructure interventions. Developing the policy has shown that we need to improve governance, capacity and community participation and ensure that water and sanitation issues are tackled by all of government not just the agencies traditionally associated with water resources management. The fact that we have formed a whole of government Water Technical Committee is testament to just how seriously we in Nauru take this problem."*

All Pacific ACP States: Regional Legislative and Regulatory Framework for Deep Sea Minerals

At the 2009 Pacific Island Forum meeting, Leaders agreed a number of key priority areas for progressing the Pacific Plan including: "developing regional and national frameworks to enable the development of the economic potential of marine mineral resources". The Key Result Area 1 of the EU EDF10 Deep Sea Minerals (DSM) in the Pacific Islands Region Project was to develop a Regional Legislative and Regulatory Framework (RLRF) for the sustainable development of deep sea minerals in the Pacific Islands Region.

The DSM Project prepared the first draft of the RLRF and submitted it to a (private sector) international environmental law expert for review, before being circulated for comment in January 2012 to representatives across Pacific-ACP States, as well as: civil society, industry, academia, and other national, regional and international agencies. This process was also supplemented by the Project's in-country national stakeholder workshops, where the draft RLRF was presented and further comments sought. All together over 300 stakeholders were consulted in the development of the RLRF to ensure that the RLRF should be balanced; and also afford appropriate protection

to the marine environment and biodiversity, while not 'over-regulating' to the extent that well-managed and transparent DSM development is not possible.

The RLRF was finalised in July 2012 and formally launched at the Pacific Islands Forum meeting in Rarotonga where the Leaders recommended that Forum Island Countries consider using the Framework in formulating relevant national policy noting it highlights the need for a precautionary approach and addresses economic, social and environmental aspects to ensure sustainable resource use prevails. The RLRF is the first document of its kind, setting clear and comprehensive guidance for States in their decision-making about DSM activities, and in developing a robust regulatory regime where DSM activities are to proceed, that is consistent with international obligations, rules and standards.

Regional: Increased capacity in-country for informed decision making in the management of vulnerability and risks

The Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI) has provided PICs with disaster risk modelling and disaster risk assessment tools. These have been developed with the financial and technical assistance of a number of partner agencies such as the World Bank, ADB, AIR Worldwide, NZ Institute of Geological and Nuclear Sciences and Pacific Disaster Center working with SOPAC Division over a 2-year period from 2010.

The tools include the following:

- Regional historical hazard and loss database for major disasters.
- Regional probabilistic hazard models for major hazards: earthquakes (both ground shaking and *tsunami*) and tropical cyclones (wind, storm surge and excess rainfall).
- Regional and national geo-referenced exposure database containing components for buildings and infrastructure, agriculture and population.
- Information on major cash crops and population.
- Country-specific catastrophe risk models and country risk profiles which includes maps showing the geographic distribution of hazards, assets at risk, and potential losses that can be used to prioritise DRM interventions.

The Pacific Risk Information System is the largest collection of geospatial risk information for the Pacific. It contains detailed, country-specific information on assets, population, hazards, and risks; a comprehensive regional historical hazard catalogue (115,000 earthquake and 2,500 tropical cyclone events) and historical loss database for major disasters, as well as country-specific hazard models that simulate earthquakes (both ground shaking and *tsunami*) and tropical cyclones (wind, storm surge, and excess rainfall) and contains risk maps showing the geographic distribution of potential losses for each country as well as other visualisation products of the risk assessments, which can be accessed through an open-source web-based platform paris.sopac.org.

Regional: 15 Complete Postgraduate Certificate Course in Integrated Water Resources Management

The scale of water and sanitation issues facing the Pacific is partially linked to a lack of water resources expertise and IWRM awareness, occurring not only at the technological and scientific level, but also in the areas of community engagement approaches, water planning and project management. In the face of climate change and population growth, water professionals can no longer focus on a single aspect of water management. Solving water-related problems requires technical and scientific expertise and greater understanding and integration of environmental, social and political factors, as well as the skills to work effectively with communities.

To help address these knowledge and competency needs SOPAC Division, with the support of the European Union, engaged the *International Water Centre* to design and deliver a Graduate Certificate Programme that provides an integrated perspective on water management. The fully accredited *Postgraduate Certificate in IWRM* includes four core modules.

- Project Management
- Science of Water
- Catchment and Aquatic Ecosystem Health
- Capacity Building and Community Development

The course was successfully completed by 15 professionals from SPC island Member countries, including 8 women, and 9 staff of Pacific IWRM Project country project management units. Through problem-based regional case studies, students learned from each other's experiences and formed a knowledge-sharing network across the Pacific. Feedback from graduates has been overwhelmingly positive. One graduate is now continuing to a Masters degree.

Regional: 12 Countries Benefit from Knowledge Development and Sharing through the GEF Pacific Integrated Water Resources Management (IWRM) Project

The GEF-funded Pacific IWRM Project was launched in 13 countries in 2009 to protect vital watersheds; manage wastewater and sanitation; assess and protect water resources; and improve water efficiency and safety. After three years of implementation, tangible on-ground impacts are now evident. Knowledge exchange is a key objective of all GEF projects but is often difficult. To increase awareness of national demonstration projects and to inform the region of the significant results achieved each country has produced result notes for the Fourth Regional Steering Committee meeting (RSC4).

Mr Christian Severin from the GEF Secretariat (who attended RSC4) commended the 12 countries for communicating their results regionally and to the rest of the global portfolio of GEF International Waters projects. He acknowledged that the Results Notes prepared and presented by 12 countries clearly show results are being achieved and provide the types of information and data that are necessary to convince politicians and other stakeholders of the benefits of investing in the critical reforms required for water and sanitation in the Pacific." The country projects' result notes now feature on the GEF Home page (www.theGEF.org).

ATTACHMENT

PROGRAMME as at 16 October 2012 (check daily at the meeting venue for updates)

Programme for 29th STAR Conference
Noumea, New Caledonia 2012
SPC Headquarters and IRD

Saturday November 3rd			
The SPC Jacques Iakewe Conference Centre Conference registration from 09:00 at SPC Conference Centre			
10:00-10:30	Opening of STAR		
10:30-10:50	Introduction policy & marine geoscience	<u>Beuf, A.</u>	The EU international strategy research & innovation: global challenges, international science, innovation opportunities
10:50-11:10		<u>White, I.</u>	Review of PACE-NET
11:10-11:30		<u>Garaebiti, E., Todman, S. & Lebellegard, P.</u>	The Oceania Regional Seismic NETWORK (ORSNET) concept
11:30-11:50		<u>White, I., Falkland, T., Buraman, H., Depaune, M., Kun, R., Rebgetz, M., Willie, R. & Mertai, E.</u>	Developing knowledge-based national water policy and implementation plans in Pacific Small Island Countries: a practical response to climate change
11:50-12:10		<u>Power, W., Wallace, L., Mueller, C., Barberopoulou, A., Wang, X. & Fraser, S.</u>	Developing a national tsunami hazard model for New Zealand
12:10-12:30		<u>Rouillard, P., Collot, J., Sutherland, R., Bache, F., Hashimoto, T. & Patriat, M.</u>	<i>The Tasman Frontier Database: a regional collaboration to promote geosciences research & natural resources in the SW Pacific</i>
12:30-13:30	Lunch break		
13:30-13:50	Coastal modelling & marine geoscience	<u>Damlamian, H. & Cummins, P.</u>	Sensitivity analysis of tsunami inundation modelling with respect to baseline data: Nuku'alofa, Kingdom of Tonga
13:50-14:10		<u>Williams, S., Goff, J., Cahue-Goff, C., Davies, T., Cheung, K., Pratsetya, G. & Wilson, T.</u>	Towards the development of a paleotsunami database in the Samoan Islands
14:10-14:30		<u>Damlamian, H. & Krüger, J.</u>	Cyclone wave inundation risk mapping, Rangiroa atoll, French Polynesia
14:30-14:50		<u>Garton, D., Gardner, J., Collen, J., & Zwart, D.</u>	Distant events may dramatically perturb atoll lagoon systems
14 :50-15 :10		<u>Collot, J., Rouillard, P., Sutherland, R. & Bache, F.</u>	Seismic stratigraphy & tectonic history of the SW Pacific
15:10-15:30	Refreshment break		
15:30-15:50	Seismology & Marine geoscience	<u>Lebellegard, P.</u>	New Caledonia & Vanuatu joint seismic networks & associated early warning system: towards a regional centre for tsunami risk mitigation
15:50-16:10		<u>Talia, L.</u>	Samoa seismic network
16:10-16:30		<u>Garaebiti, E.</u>	Vanuatu volcano real-time monitoring network - support to the Melanesian Volcano Network
16:30-16:50		<u>Forstreuter, W.</u>	<i>Potential of unmanned aerial vehicles for beach profiles of low-lying islands</i>
16:50-17:10		<u>Tawake, A.</u>	An update on the implementation of the Regional SPC-EU Deep Sea Minerals Project

John Collen

17:10-17:30		<u>Forstreuter, W. & Bataua, K.</u>	Vegetation change detection for low-lying islands: a quantitative approach
18:00-20:00	Ice Breaker Meetings of Working Groups		

Sunday November 4th

13:00-16:00	Barbecue and Volleyball Tournament Gardens at rear of IRD Centre
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Monday November 5th

The IRD Auditorium Conference registration from 07:30 at IRD			
08:30-08:50	Repeat opening of STAR for newcomers		
08:50-09:10	Climate change observations	<u>Allenbach, M. et al.</u>	Presentation of the French National Climate Change Observatories Network IFRECOR
09:10-09:30		<u>Aucan, J.</u>	Historical sea level change in Noumea 1967-present
09:30-09:50		<u>Thierry, H., Allenbach, M., Malau, A. & Liufaud, E.</u>	Oceanologic monitoring of the Wallis Islands lagoon during global climate change
09:50-10:10		<u>Kuchinke, M. & Lenton, A.</u>	Ocean acidification & ENSO: decadal trends in the western equatorial Pacific sea surface aragonite saturation state
10:10-10:30		<u>Kashino, Y., Ando, K., Ishihara, Y., & Hasegawa, T.</u>	Ocean observations in the western equatorial Pacific - Triangle trans-ocean buoy network (TRITON) buoys
10:30-10:50	Refreshment break		
10:50-11:10	Climate change & adaptation	<u>Houlbrèque, F., Rodolfo-Metalpa, Jeffrey, R., Oberhänsli, F., Teyssié, J., Boisson, F. & Ferrier-Pagès, C.</u>	How are major coral species of New Caledonia going to face climate change?
11:10-11:30		<u>Wiles, P., Vavae, H., Tausi, L., Nakalevu, T. & Leavai, P.</u>	Climate variability and adaptation in Tuvalu
11:30-11:50		<u>White, I.</u>	Lumped characteristics of rainfall harvesting in the central Pacific
11:50-12:10		<u>Descloux, E., Mangeas, M., Menkes, C., Leroy, A., Guillaumot, L., Grangeon, J., Benzler, J., Teurlai, M. & Cavarero, V.</u>	<i>Climate-based models for understanding and forecasting dengue epidemics in New Caledonia & perspectives for the South Pacific</i>
12:10-12:30		<u>Cao-Lormeau, V.M</u>	Dengue risk and emerging arboviruses management in the Pacific (DREAM Pacific)
12:30-13:30	Lunch break		
13:30-13:50	Climate change, adaptation & technology	<u>Lefèvre, J., Menkes, C., Rodier, M., Bani, P., Marchesiello, P., Curci, G., Grell, G. & Frouin, R.</u>	Transport of volcanic gases from Vanuatu and implications
13:50-14:10		<u>Krüger, J.</u>	Mapping shoreline change and setback options, Lifuka, Ha'apai, Tonga
14:10-14:30		<u>White, I., Falkland, T. & Fatai, T.</u>	Vulnerability of groundwater resources in Tongatapu
14:30-14:50		<u>Nell, J.</u>	Water production
14:50-15:10		<u>Irvine, J.L., Lin, C. & Yang, P.</u>	An innovative greywater treatment scheme applicable for Pacific Island communities
15:10-15:30	Refreshment break		

15:30-15:50	Marine science	<u>Menkes, C.</u> , Lengaigne, M., Margot, B., Wenju, C., Borlace, S., Lefèvre, J., Jullien, S., Marchesiello, P. & Masson, S.	The South Pacific Convergence Zone: present & future
15:50-16:10		<u>Cravatte, S.</u> , Ganachaud, A., Marin, F. & SPICE contributors	Achieved and expected scientific advances from the SW Pacific Ocean Circulation & Climate Experiment (SPICE)
16:10-16:30		<u>Kumar, S.</u> & Kumar, A.	Tracking of tropical cyclonic storms and thunderstorms in the South Pacific region – application of World-Wide Lightning Location Network
16:30-16:50		<u>Suetsugu, D.</u>	<i>Seafloor geophysical observations for origin of the Ontong Java Plateau</i>
16:50-17:10		<u>McAadoo, B.</u>	Tsunami risk: lessons learnt from Samoa, the Solomon Islands, and other recent disasters
17:10-17:30		<u>Forstreuter, W.</u>	Need and new design of reference image points for Pacific Island Countries
17:30-18:00		STAR Business Meeting	

Tuesday November 6th	
SPC/SOPAC Division Meeting/STAR The SPC Jacques Iakewe Conference Centre	
08:30-09:15	Opening & welcome
09:15-10 :00	Reports <ul style="list-style-type: none"> ▪ Director's report: Introduction ▪ Report on KRAs ▪ Report on highlights ▪ Report on emerging issues & opportunities
10:00-10:30	Official photograph & morning tea
10:30-12:00	Reports (continued) <ul style="list-style-type: none"> ▪ PMEG Reports ▪ STAR Chair Report
12:00-13:00	Lunch break
13:00-15:00	SOPAC Division highlights, emerging issues & opportunities <ul style="list-style-type: none"> ▪ French Polynesia: Tuamotu Archipelago – reducing the risk of storm wave and surge ▪ Fiji: an integrated approach to water resources and flood management in the Nadi Catchment ▪ Federated States of Micronesia: Construction of Emergency Operations Centres and DRM Training Provided
15:00-15:30	Refreshment break
15:30-17:30	SOPAC Division highlights, emerging issues & opportunities (continued) <ul style="list-style-type: none"> ▪ Solomon Islands: institutionalisation of Disaster Risk Management training ▪ Tonga: Lifuka Island – an integrated and multi-disciplinary approach to adaptation and coastal threats in the Ha'apai Group Discussion on emerging issues and opportunities (Session 1)
18:00	Reception

Wednesday November 7th	
SOPAC Division Meeting The SPC Jacques Iakewe Conference Centre	
08:30-10:30	SOPAC Division highlights, emerging issues & opportunities (continued) <ul style="list-style-type: none"> ▪ Cook Islands, Niue, Kiribati, Tokelau, Tuvalu, Nauru and the Marshall Islands: Maritime Boundaries Agreements signed ▪ Tuvalu, Marshall Islands, Nauru, Tonga and Vanuatu: ecosanitation promotion (EcoSan Toilets "on the move") ▪ Nauru: national policy and planning frameworks for water, sanitation and hygiene

10:30-11:00	Refreshment break
11:00-12:30	SOPAC Division highlights, emerging issues & opportunities (continued) <ul style="list-style-type: none"> ▪ All Pacific ACP States: regional legislative and regulatory framework for deep sea minerals ▪ Regional: increased capacity in-country for informed decision making in the management of vulnerability and risks
12:30-13:30	Lunch break
13:30-15:00	SOPAC Division highlights, emerging issues & opportunities (continued) <ul style="list-style-type: none"> ▪ Regional: 15 complete Postgraduate Certificate Course in Integrated Water Resources Management ▪ Regional: 12 Countries benefit from knowledge development and sharing through the GEF Pacific Integrated Water Resources Management (IWRM) project
15:00-15:30	Refreshment break
15:30-16:45	SOPAC Division highlights, emerging issues & opportunities (continued) <ul style="list-style-type: none"> ▪ Technical support services ▪ Discussion on emerging issues and opportunities (Session 2)
16:45-17:30	Summary discussion for Chair's report

Thursday November 8th	
SOPAC Division Meeting The SPC Jacques Iakewe Conference Centre	
08:30-10:00	Summary discussion for Chair's report (continued)
10:00-10:30	Refreshment break
10:30-12:00	2013 SOPAC Division Work Plan and Budget
12:00-13:00	Lunch break
13:00-15:00	Strategic planning session for members and staff – may be closed session
15:00-15:30	Refreshment break
15:30-17:30	Strategic planning session for members and staff – may be closed session
Friday November 9th	
SOPAC Division Meeting The SPC Jacques Iakewe Conference Centre	
08:30-10:00	Strategic planning session for members and staff – may be closed session
10:00-10:30	Refreshment break
10:30-12:00	Strategic planning session for members and staff – may be closed session
12:00-13:00	Lunch break
13:00-	Clearing of Chair's Summary Report Closure of SOPAC Division Meeting
18:00	Closing reception – open to all