Pacific Islands
GIS&RS news

The Newsletter of the GIS/Remote Sensing Users in the Pacific
Issue 1/2004
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High-Resolution Image Data also in Samoa, Niue, Solomon Islands and Cook Islands.

All GIS applications detailed in this newsletter require image data as the information source. High-resolution colour image data has been purchased for several Pacific Island Countries under the SOPAC-EU Project. Late last year, this image data for mapping at 1:10,000 scale was available for Tonga, Tuvalu and Vanuatu while this year Cook Islands, Kiribati, Niue, Samoa and Solomon Islands were supplied with the same. For Cook Islands and Solomon Islands QuickBird data was delivered, providing a resolution of 60 cm in panchromatic mode. In Fiji, Kiribati, Tonga and Tuvalu the new image data is also available on the MapServers installed by the SOPAC-EU Project.

This newsletter explains that another satellite records high-resolution image data in colour from Pacific Island Countries and details the advantage of having a mobile ground receiving station in the Pacific that would allow the collection of greater cloud-free image data and the data would be available directly after recording. This could expand the application of image data such as fishing vessel detection and post disaster analysis.

For all countries that received image data, training was provided to produce GIS backdrops out of the images and to utilise the image data for on-screen digitising. The last newsletter reported about image data applications in Fiji, where Fiji Pine Ltd used them to separate bush and Pine vegetation. This type of application requires image enhancement to increase the contrast between features of interest and to undertake this in a sustainable manner, an understanding of the nature of digital images is essential, which requires a new level of training for GIS officers and SOPAC will provide this training next year. It should be noted that Pacific Island Countries need to express their interest in receiving such support, as SOPAC only can act on demand. Remote Sensing and subsequent training in this area is currently only handled through the SOPAC-EU Project, which expanded from eight to fourteen countries without increasing the GIS and Remote Sensing staff. It is therefore impossible to serve all fourteen countries within the remaining one year period of the project and countries will be selected that address their training needs in time.

Wolf

The image shows a small area beside the airport in Honiara. The spatial resolution of 60cm provided by the pan-sharpened QuickBird image allows the separation of palm and other vegetation cover through the texture.

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Content

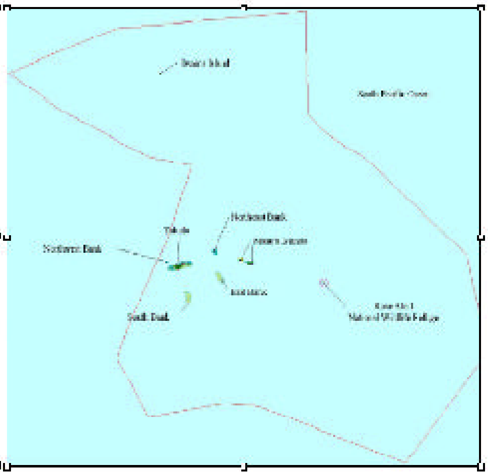
IKONOS pan-sharpened

The image shows the stadium in Athen, where the Olympic games took place.

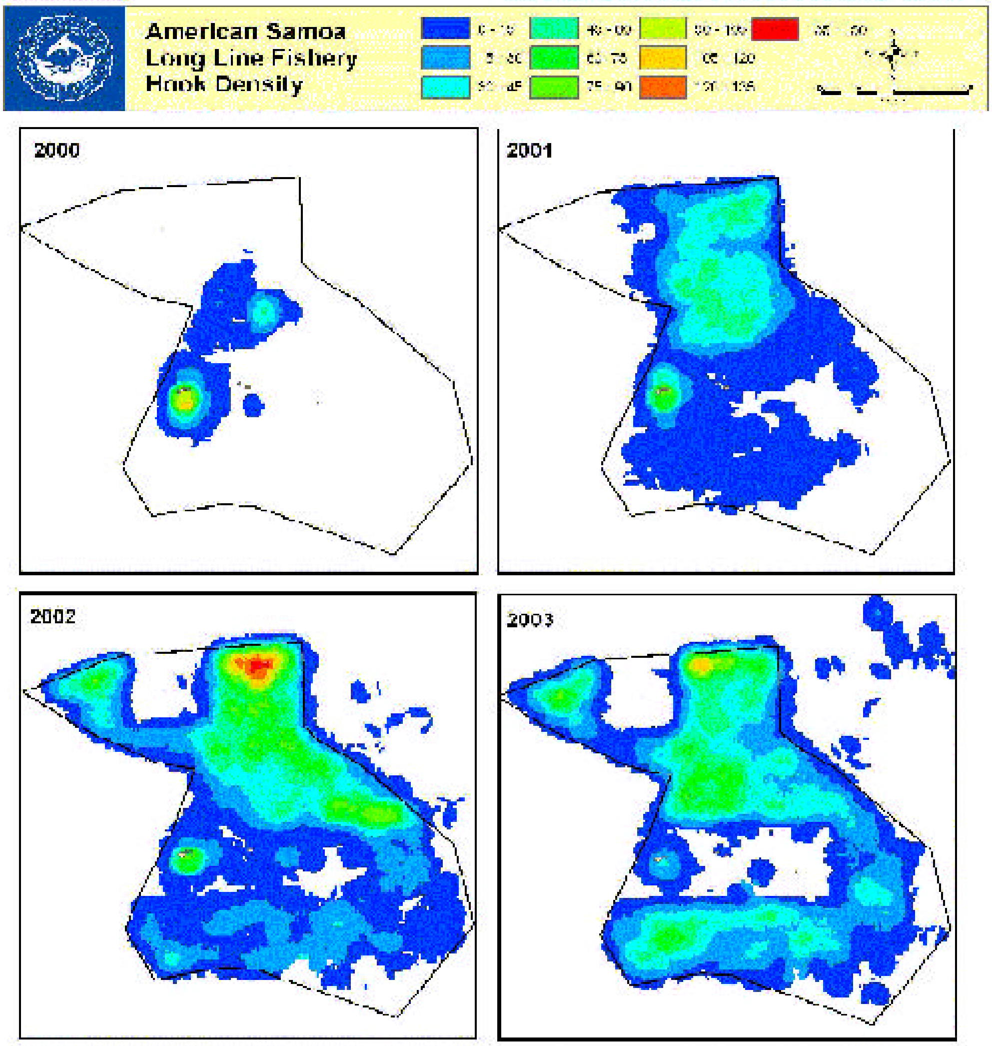
GIS Activities at the Department of Marine and Wildlife Resources in American Samoa, JAN - MAY, 2004

Francesca Riolo

After an initial period of orientation spent familiarizing with existing data, hardware and software as well as establishing contacts with other people involved with GIS in American Samoa, the new GIS Specialist, Francesca Riolo, started a number of GIS projects and activities for the Department of Marine and Wildlife Resources and Coral Reef Advisory Group agencies and liased also with external projects like the NOAA Multibeam Seabed Mapping and the Biogeography Benthic Habitat Mapping projects.

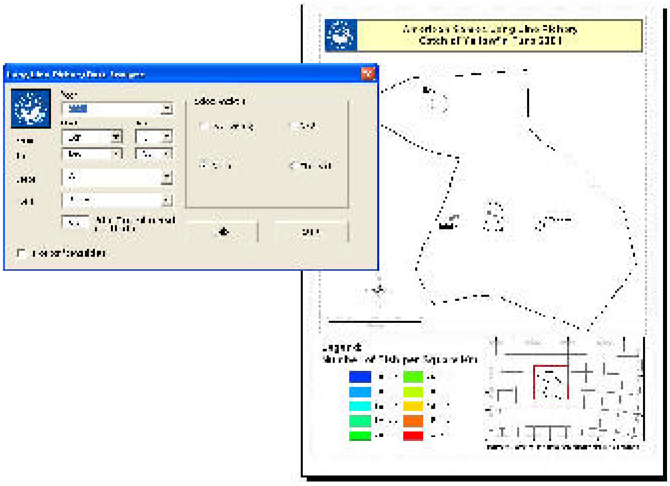


GIS activities ranges from basic map production undertaken under request for different DMWR programs (e.g. Community Based Fishery Management Program, Marine Protected areas) and other CRAG agencies (e.g. American Samoa Environmental Protection Agency (ASEPA), Fagatele Bay National Sanctuary, American Samoa National Park) to more complex spatial analysis of fisheries data, spatial data production, conversion and maintenance, and GIS software customisation and development for the above purposes.



The use of GIS and mathematical algorithms for MPAs Network design was investigate and brought to the attention of people involved in the MPA program.

New benthic habitat mapping data and classification schema were acquired from the NOAA Biogeography group. Liaison is ongoing to organize their next trip to American Samoa in July to validate the new habitat data.



In collaboration with ASEPA maps of CALM Assessment Categories of water quality for Streams, Wetlands and Ocean Shoreline for Tutuila and Manu'a Islands were developed. These maps were inserted in the ASEPA annual report to be submitted to US federal EPA. A geo-dataset is going to be developed containing all ASEPA and related agency monitoring stations and their attributes.

Multibeam data collected during the NOAA survey in selected shallower area (<30 meters) are being used to test the accuracy of P. Stumpf and K. Holderied algorithm in deriving bathymetry from IKONOS satellite images. IKONOS images initial processing and metadata identification were the first steps of this project. Choice and tuning of the algorithm parameters is the current work carried out in collaboration with Ken Cochran and Kris Holderied. There is the believe that this method will give results with a reasonable accuracy to cover the existing bathymetry gap providing highly valuable data in coral reefs depth ranges.

GIS and Spatial Analysis techniques are being used to analyse and display the entity and the success of longline fishing pressure in the American Samoa Exclusive Economic Zone (EEZ) (figure 1). There was a clear lack of understanding the spatial distribution of fishing activities prior to this study. The study is based on the data collected by DMWR as part of the federal longline logbook system implemented by NMFS since 1996 containing detailed data on each fishing set and the resulting catch for all registered vessels.

Fishing pressure maps were developed based on spatial density of deployed longlines weighted by number of hooks (figure 2). Total catch and catch for key species (Albacore, Skipjack and Yellowfin Tuna and others) is also being mapped using spatial density techniques (figure 3). Catch per Unit of Effort (CPU) maps are produced as ratio between the above outputs. A Visual Basic/ARCObjects application was developed to automate the retrieval of the longline fisheries data, output production and to provide a user-friendly analysis interface.

Other GIS work is being performed in American Samoa by other Department and Agencies. American Samoa has a very active GIS user group. To know more about other GIS projects and group members you can visit the following websites:

http://groups.yahoo.com/group/AmSamoa_GISusers/ (Yahoo user group) and http://doc.asg.as/ (AS GIS user group website)

The ASGIS User Group was recently notified by ESRI to be selected for the "Special Achievement in GIS" award. The award is given to sites around the world in recognition of outstanding work in the GIS field. The site was one of 150 sites chosen from 100,000 ESRI user sites worldwide.

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Sewage Plume Mapping in South East Queensland, Australia

Chris Roelfsema, James Udy

Dr.James Udy and Chris Roelfsema, from University of Queensland, Australia, visited SOPAC and USP in Fiji to discuss collaborative projects. James presented research conducted as part of the Ecological Health Monitoring Program. Since there was so much interest during that presentation we decided to write this article about sewage plume mapping.

As part of the Ecological Health Monitoring Program in South East Queensland Australia sewage plumes are being studied in the coastal, river and estuarine waters. These sewage plumes are being assessed by simple techniques which combine biological indicators with GIS mapping tools. Sewage nitrogen mapping assesses the extent of sewage treatment plant discharges into South East Queensland (SEQ) waterways through measurements of the uptake of the stable nitrogen isotope 15N by the macroalga *Catenella nipae*.

Why is it measured?

Sewage effluent is discharged into many estuarine and coastal waters throughout SEQ. It is important to trace the source and extent of sewage effluent in receiving waters to broadly gauge the contribution of wastewater to nitrogen pools in the receiving estuaries such as the Moreton Bay in South East Queensland (Figure 2). Marine plants incorporate nitrogen from the surrounding water column and reflect the isotopic signature of the source nitrogen. In the South East Queensland monitoring program, the marine red macroalga *Catenella nipae* is used as a tool to detect the presence of sewage-derived nitrogen. ä15N values of *Catenella* range from 2‰ in non-sewage impacted waters through to 10‰ adjacent to sewage discharge sites. By evaluating the changes in ä15N values of the algae following incubation in situ, it is possible to determine the extent of sewage plumes in the water.

How is it done?

To get started you first need impacted by *Catenella* which has negligible impacts by sewage. For the monitoring program they are collected from the pneumatophores (aerial roots) of mangroves at Myora on North Stradbroke Island (South East Queensland).

The *Catenella* samples are deployed in specially designed deployment units at several of the water quality monitoring sites with known GPS coordinates. Each unit consists of two chambers filled with *Catenella*, with holes, attached to a rope using cable ties. The chambers are secured opposite each other at1/2 Secchi depth (to standardise light availability across a range of water clarities). A white marker buoy is attached to the top of the rope to find it the samples back and weights to the other end of the rope to anchor it to the bottom (figure 1). The units are retrieved after four days and the algae are transferred to the laboratory for further processing. Samples are then dried and grinded in to a fine powder and then oxidized. The resultant was then analysed in a mass spectrometer to determine the nitrogen stable isotope signatures (d15N).

Using GIS package such as Arcview the values are then mapped per site using the GPS coordinates. By interpolating between the site a file is created which shows areas with similar amounts of the nitrogen stable isotope signature. This is conducted on a yearly basis and results in maps as shown (figure ??).

This article is based on information give in:

EHMP (2004). Ecosystem Health Monitoring Program 2002-2003 Annual Technical Report., Moreton Bay Waterways and Catchments Partnership, Brisbane, Australia.

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Progress on the Deployment of Mapservers in the Pacific Islands

Franck Martin

The deployment of MapServers in the Pacific is continuing with the EDF8 countries nearly completed while we are starting to roll out EDF9 countries. There has been some interesting layers added in various countries and a workshop was conducted in Vanuatu in August 2004 to define some development priorities for the successful utilisation of MapServers.

A system for all to use and contribute to

The MapServers are web servers that provide interactive digital maps to a wide range of end users. They are easy to use and anybody, with a little bit of training, can contribute by adding maps, layers or text to the servers in countries. So far, Fiji, Kiribati, Papua New Guinea, Tonga, Tuvalu, and Vanuatu have a MapServer online. The servers now belong to the countries and can be used by local governments, private enterprises, non-governmental organisations, other regional organisations and private consultants to record relevant geographic information on a system which is local to the population.

E-Government, Governance and Transparency

This is a form of e-government and the first application to be widely deployed in the Pacific. This activity is only one component of a wider project named “Reducing Vulnerabilities in Pacific ACP States” which is funded by the European Union and managed by SOPAC. Indeed this system is here to reduce vulnerabilities by better decision-making and added layers of transparency. The maps published allow the public at large to check that the government, companies, donor agencies and others have a correct assessment of the local situation. By having the correct “picture”, they can make the correct decisions

High Resolution Imagery

In some of the servers the high-resolution satellite imagery from this EU Project has been added on some working areas. This imagery provides between 4 m to 60 cm resolutions. Fiji, Tonga, Tuvalu, Kiribati and Vanuatu have such layers while we are working on the other countries.

Sea bed never seen before

Accurate bathymetric layers have also been added in some countries, Fiji, Tonga, Tuvalu and Vanuatu have some of these layers. The survey vessel is progressing towards Kiribati. A bathymetric map

➨*continuation page 15*

Fiji’s Remote Forests Offer a Last Refuge for Endangered Wildlife

David Olson

Wildlife Conservation Society

Do remote forests on larger islands provide a refuge from the predatory activities of introduced rats and mongoose? Several offshore islands are predator-free or can be cleaned of rats, but what about forests on the larger islands which are home to many more native species? An intensive baiting survey on Viti Levu by the Wildlife Conservation Society (WCS) Om Prasad (USP Biology), Waisea Naisilisili (WCS), Craig Morley (USP Biology), David Olson (WCS)) is finding that remote forests more than 4.5 to 5 km from the forest edge have a much reduced level of rat and mongoose activity. In these remote forests, none of 200 roasted coconut baits were taken in one night and no wax-coconut oil baits after one month. The pattern is the same for baits on the ground or in trees. Nearly all 200 baits are gone after one night near the forest edge and the level of bait activity decreases with distance into the forest. Will sensitive species, such as the pink-billed parrotfinch, banded iguana, *Placostylus* land snails, and giant walking stick, be better able to maintain healthy populations in these remote forests? A GIS analysis of Fiji’s natural forest cover – thank you SOPAC and Fiji Department of Forestry for sharing forest cover data – where we buffer 5 km inwards from all forest edges, reveals few such areas remain. Only Serua, the central Waimanu watershed, the upper Sovi Basin, and Namaranucia qualify as remote forests. Vanua Levu has very few areas that qualify as remote forest, while Taveuni has a large area on the SE slope (Ravilevu). WCS is now gathering independent data on the abundance of rats and mongoose in different parts of the forest, and surveying sensitive species to see if their abundance is greater in remote areas. Logging roads bring in rats and mongoose, and as they are bulldozed further and further into the interior they will soon make no forests “remote”. A map of priority remote forests may help Forestry, Environment, provinces, and landowners better balance economic and conservation goals. These results have similar implications for conservation efforts in New Caledonia, Vanuatu, Samoa, Hawai’i, and the Solomon Islands where larger blocks of forest still remain and introduced rats and mongoose represent a threat to wildlife.

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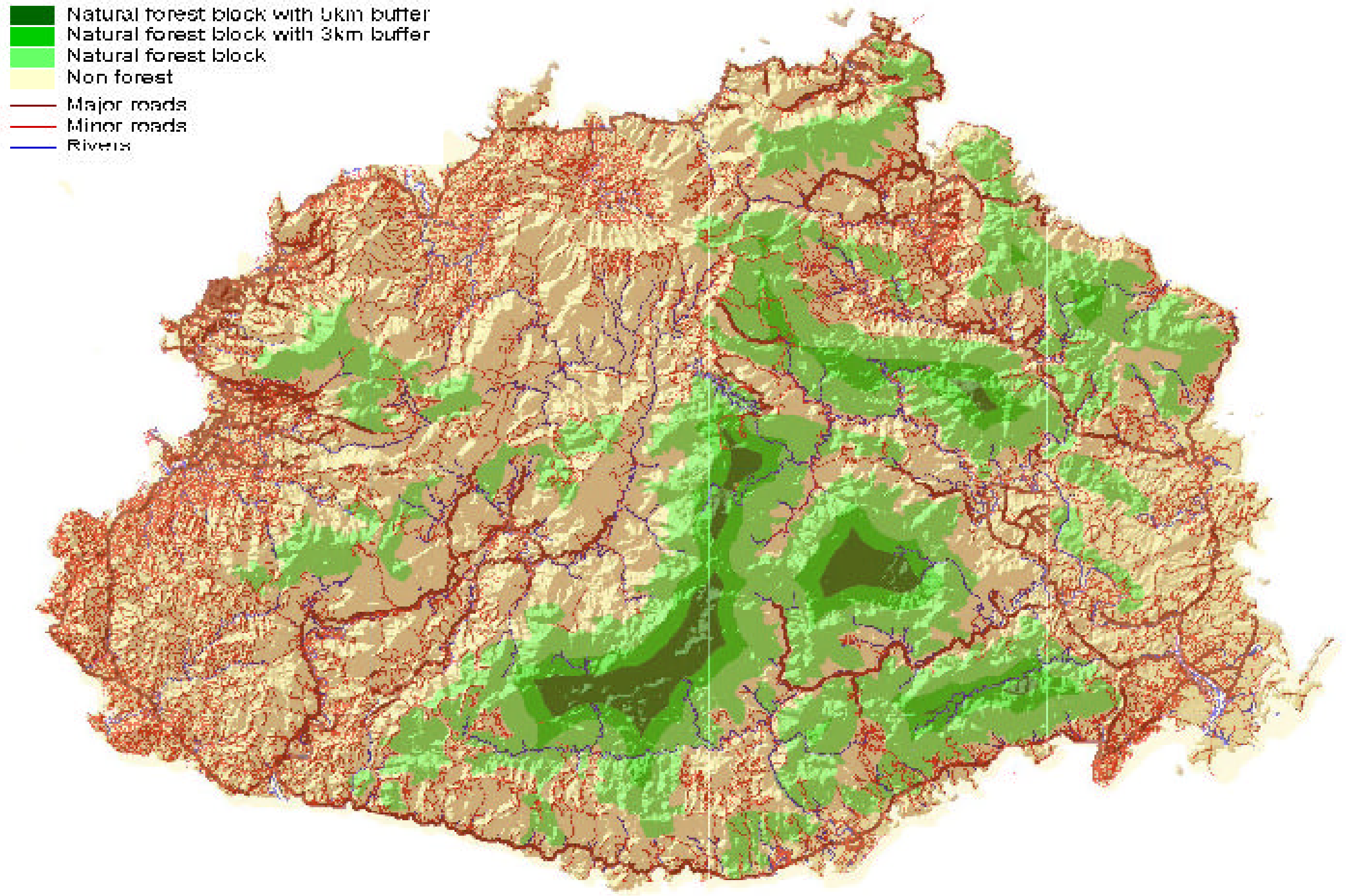

Hierarchical Land Cover Classification for Hawaii

Steven Hochart

Hawaii Gap Analysis Program, University of Hawaii, Honolulu
US Infrastructure-Hawaii, Honolulu

Introduction

The state Gap Analysis projects each have developed approaches to image interpretation. In Hawaii, most of the land area has been surveyed at some time, and detailed vegetation classifications are available for more than a dozen significant areas covering portions of each island.

GAP led the development of the Multi-Resolution Land Cover Consortium (MRLC), and GAP state projects enjoy access to the MRLC archive (Hegge et al. 2001). In most cases this includes Landsat Thematic Mapper 7 images available for each path/row representing three seasons. Under the MRLC these images are preprocessed to standardize geographic location as well as correct for terrain displacement and atmospheric haze. Additionally, the EROS Data Center now makes MRCL images available that have been corrected to “at-satellite radiance values” (Homer and Hegge, EROS Data Center/ Raytheon). The process also employs the Sun-Earth and Earth-radiometer distances at the time of the image to compensate for the radiometric distortion effects of the Earth’s atmosphere, making images taken on different revolutions more comparable. The Hawaiian entry for MRLC “at-satellite radiance” images had not been populated prior to the HI-GAP effort, and we were able to partner with EROS Data Center to select and process scenes for each path/row representing seasonality as well as completing a cloud-free mosaic using Landsat TM images from 12/99-12/02. These scenes represent a remarkably consistent data set on which the HI-GAP spectral decision tree classification was implemented.

Classification Research

Several image interpretation methods were experimented with for the HI-GAP application. Classification and Regression Tree Analysis was considered for its objectivity and statistical strength (De’ath and Fabricius 2000, Hansen et al. 1996, Lawrence and Wright 2001), but this approach requires a significant investment in field data collection, and much of the land area in Hawaii has been previously surveyed.

Hawaiian vegetation systems are relatively well-studied and have been mapped and classified several times previously. Detailed vegetation maps are available for significant portions of many of the Hawaiian Islands. Additionally, previous and concurrent land cover research has led to a significant spectral signature library for Hawaiian native and invasive vegetation types. Research at The University of California, Santa Barbara has focused on employing aspects of spectral signatures to perform classifications on AVRIS hyperspectral imagery (Roberts et al. 1998, Serrano et al. 2000). But AVRIS imagery is not available statewide, and Landsat 7 TM data does not have sufficient spectral resolution to enable a library/signature-based approach under the conditions and needs of HI-GAP. A more ecologically driven classification approach has been developed at the Duke University Nicholas School of the Environment, where radiometric enhancements are employed to enable classification based on “natural” variables such as level of vegetation or soil exposure (Khorram et al. 1992). Also, three recent case studies developed for mapping impervious surfaces from Landsat 7 ETM were consulted for their possible applicability in land cover mapping approaches for HI-GAP (Yang et al., in review).

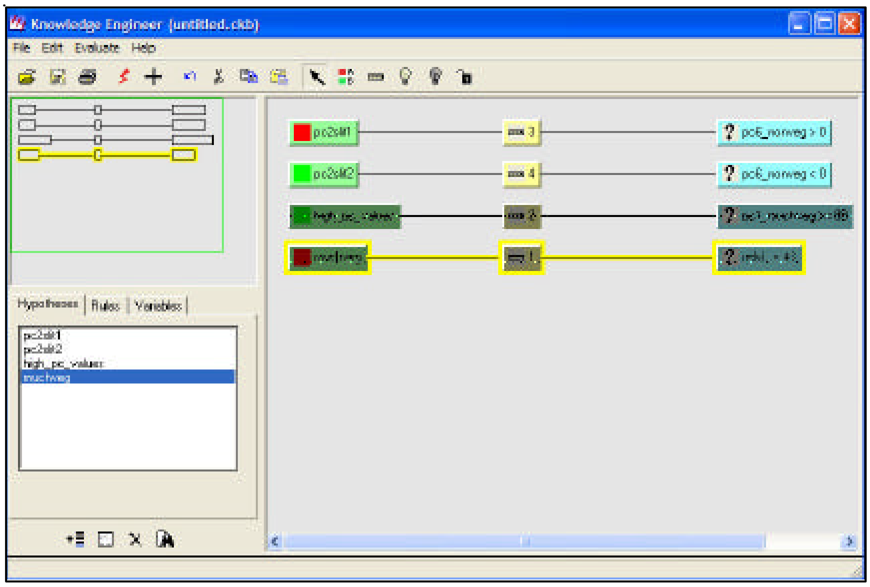

***Figure 1:** Knowledge Engineer Interface in ERDAS Imagine*

Classification Methodology

After extensive research on different methods for land cover classification in Hawaii, the HI-GAP team chose to employ an ecologically driven spectral decision tree approach to land cover classification. The approach is based on the application of ERDAS Imagine's Knowledge Engineer software platform in Figure 1. The Knowledge Engineer was selected because it provided the hierarchical structure to perform image classification and provided a good platform for storing and analyzing spectral properties. Knowledge Engineer files were developed for each image, and then integrated into a central Knowledge Engineer to produce the final classification.

The first stage in this process is removing the ocean by masking the image. The remaining areas of water are the first branch of our decision tree classification. These areas have strong absorption of near-infrared light and therefore very low values in Landsat band 4. We are able to use this "natural" or "ecological" property to form the basis of a decision. If the values recorded for band 4 are below a defined cutoff point, then we expect those cells to represent standing water and classify those areas accordingly. We are able to clearly identify areas of industrial or urban land cover as having very high reflectance in certain raw bands and can build this principle into a spectral decision tree classification.

Many of the vegetation types in Hawaiian forests cannot be distinguished clearly from the information available in raw TM bands for a variety of reasons, ranging from complex topography to small-scale mosaics of adjacent vegetation types within a limited geographic area. We employ two techniques to address this natural complexity. First, vegetation is well known to have a low reflectance in Landsat band 3 (0.63-0.69 nm) and a high reflectance in Landsat band 4 (0.76-0.90 nm). As a result, vegetation indices have been designed to isolate this spectral feature and distinguish the amount of vegetation in an area. We use the standard Normalized Difference Vegetation Index (NDVI) to build a branch in our decision tree separating areas of high biomass from areas of low biomass as indicated in Figure 2. Using treatments such as the NDVI, Principal Component Analysis (PCA), and tasseled cap, we are able to find "cut points" or variables at which we can build branches for our classification tree illustrated in Figure 2.

The tasseled cap treatment is particularly valuable in the Hawaiian High Islands ecosystem because of its utility in revealing brightness, greenness, and wetness as illustrated in Figure 3. These variables are strong identifiers for Hawaiian vegetation communities, since their distributions are closely tied to moisture availability, exposure, and nutrient availability (Pratt and Gon 1998, Wagner et al. 1999). The Tasseled Cap images at the end of the classification tree in Figure 1 are used to identify vegetation types within the study site. The Tasseled Cap values for vegetation types are identified using area of interest analysis in ERDAS Imagine.

Establishing the spectral decision tree within the Knowledge Engineer in one area enables the analyst to easily test and refine the decision trees in similar areas. When applying a decision tree to a new scene, it has often been found that only minor adjustments are needed to apply it in different places or the same place under different conditions. However, when scenes of wholly different seasons are used, we find significant adjustments are required in the classification, particularly in areas of grasslands and invasive shrubs, where changes in greenness due to "green-up" are substantial. Being aware of seasonal variation and its effects

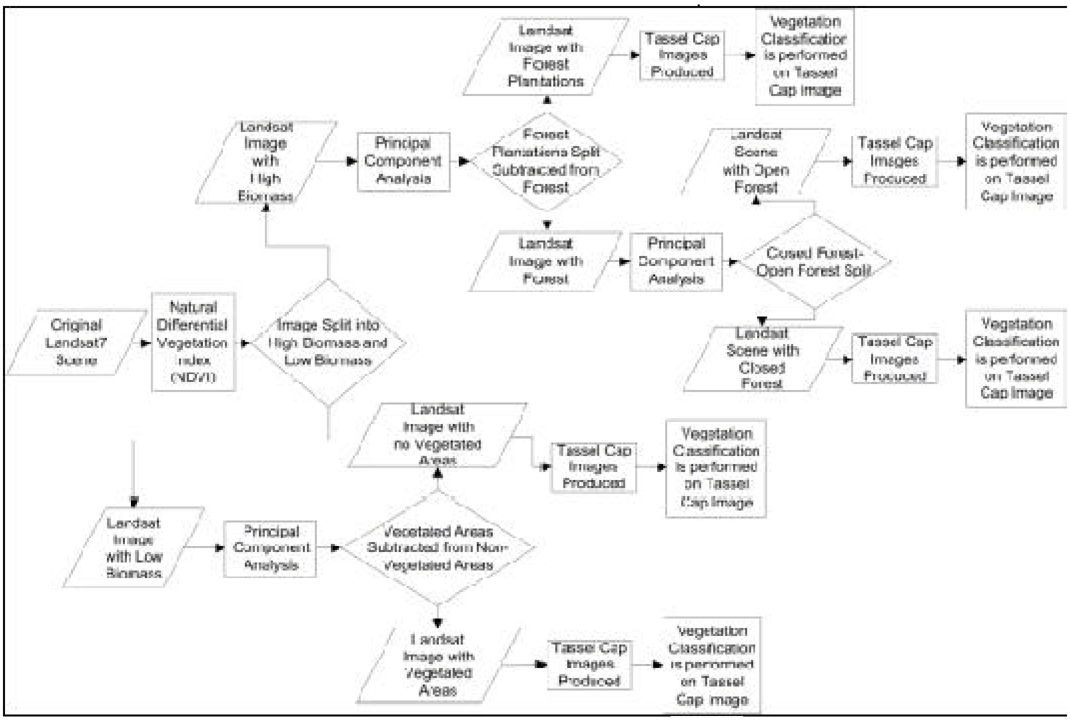

Figure 2. *Image Classification Decision Tree*

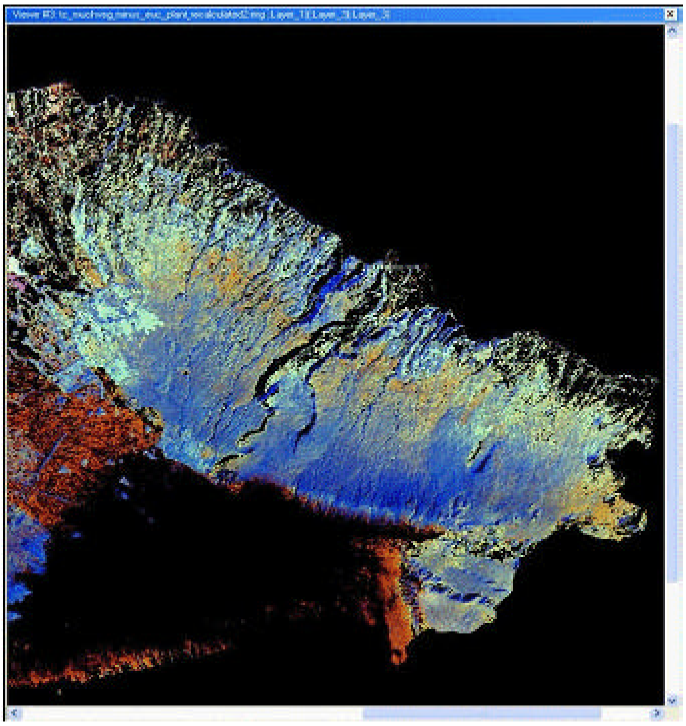

Figure 3: *Tasseled Cap Image of the forested area on the island of Maui. The blue shades represent green wet forest while the red shades represent brown dry grasslands.*

on particular vegetation types enabled the HI-GAP team to adapt the classification to take advantage of seasonality differences in the tropics.

Results

The spectral decision tree classification has been implemented on the Big Island of Hawaii, Maui, Lanai, and Molokai with positive results. The Big Island of Hawaii was the first island that was classified using this methodology, because it provided a wide variety of vegetation types with which to develop the decision tree methodology. The results for the southern forested regions of the Big Island were assessed using field point data gathered during helicopter surveys. The preliminary results indicate a 90% accuracy level for this region. Spectral properties for specific vegetation types were taken from the Big Island and applied to Maui and Molokai. The spectral values needed small adjustments to achieve the desired results. Results from the first draft have been reviewed and approved by various partners in Figure 4. Based on the work from the first draft on Maui and Molokai it is clear that spectral values gathered from the Big Island can be applied to other islands as initial hypotheses and then adjusted according to ancillary data and expert knowledge.

The minimum mapping unit for the HI-GAP project is 90 m2. The methodology described above has provided accurate results at this scale where it has been tested. The same methodology was recently tested on a small area of vegetation on the Big Island of Hawaii. The results from this test indicate the methodology can be applied at smaller spatial scales than 90 m2. The results from this study produced a detailed vegetation map with 30-meter pixel resolution. The significance of these results indicates the methodology being developed can be applied to small areas and is capable of producing detailed vegetation classifications of these areas.

Conclusion

The Knowledge Engineer approach to developing a classification tree enabled the HI-GAP team to readily test refinements and alternative classification decisions and to analyze the effects of alternative approaches on results. It employs the objectivity and repeatability of CART but augments statistical outcome with the strength of local knowledge and the ability to refine and adapt the decision tree as information becomes available. Results to date indicate the

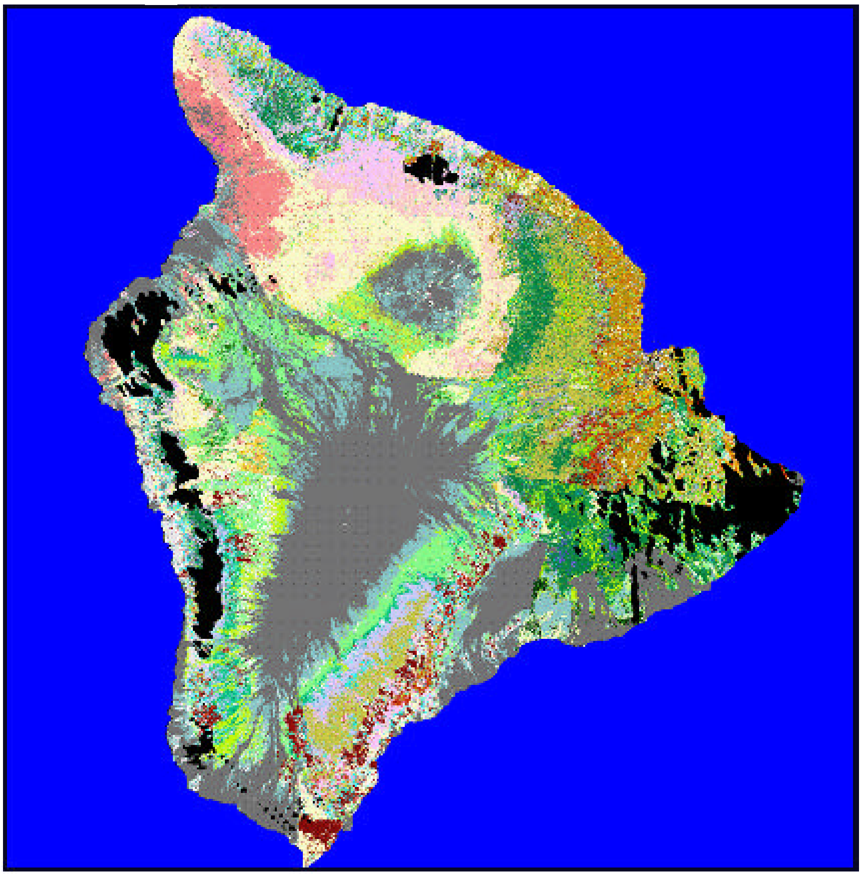

Figure 4: *Final Land Cover Classification for the Big Island of Hawaii.*

methodology described here provides a new approach to mapping tropical land cover. Where available knowledge is limited, the upper levels of the classification hierarchy can be initially characterized, and as ground-truthing or surveys provide more extensive knowledge on the vegetation composition in the study region, the decision criteria can be further refined without discarding previous work, greatly enhancing the utility of foundation efforts.

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Acknowledgements

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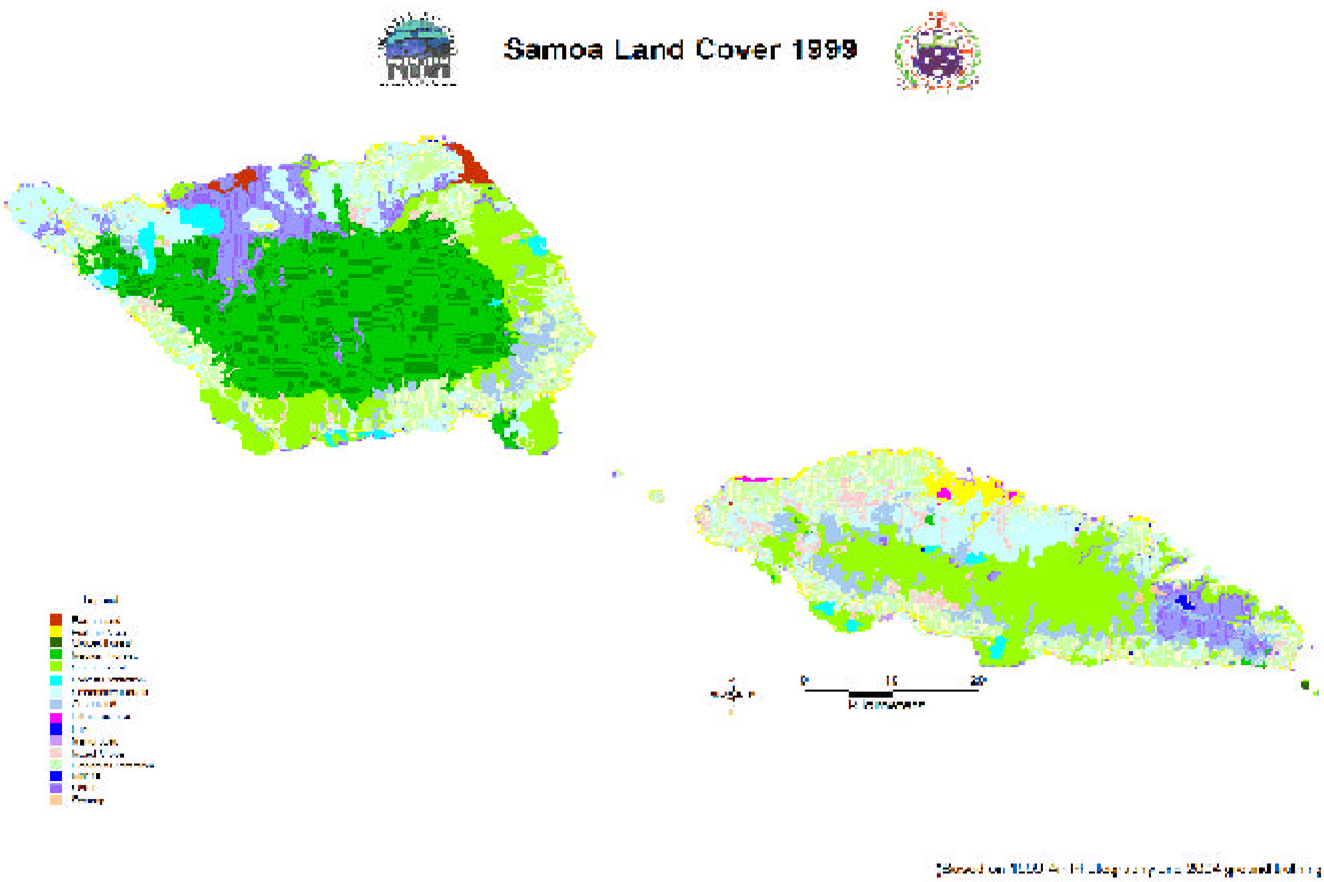

Samoa Forestry Division Develops a Forest Resource Information System

James Atherton

The Samoa Forestry Division / FAO project "Strengthening the Institutional Capacity of the Samoa Forestry Division (SFD) to Effectively Plan and Manage Forest Resources" is providing the SFD with the necessary equipment and training to upgrade its capacity to assess, manage and monitor the remaining forest resources of Samoa. The project is setting up the Samoa Forest Resource Information System (SamFRIS), that will provide the SFD with the necessary planning data to manage the natural forest resources and plantation forests in a sustainable way.

The SamFRIS project began in mid 2003 and has now completely re-mapped the country's forest resources based on 1999 aerial photographs into a MapInfo-based GIS. In addition, a comprehensive forest survey involving more than 400 survey plots has been conducted to gather data about the structure and quality of Samoa's forests. This information has been entered into an Access database which is linked to the GIS. Forestry Division staff have now been trained in forest survey techniques, in the use of GPS, and in GIS database design, development and management. Staff are currently being trained in spatial analysis and the use of SamFRIS for forest resource management. Mapping of non-forest land cover will be done at a later stage in close collaboration with other Government and Non-Government Organisations. FAO funding will end in early 2005 but it is hoped that the SamFRIS information system will be further developed and refined in the years to come.

Provisional results from the forest survey and mapping indicate that Samoa still has approximately 45% native forest cover (55% of Savaii and 30% of Upolu), but that most of the forest has been severely degraded by recent cyclones and has a very open, patchy canopy. There are now very few areas of closed canopy forest remaining in Samoa, with the most intact areas remaining in sheltered valleys and on some of the small offshore islands. Another finding is that secondary forests and invasive species are becoming increasingly widespread throughout Samoa, as a result of disturbance from cyclones and agricultural activity.

With the new training provided and comprehensive information system developed, the Samoa Forestry Division are now much better able to manage and improve Samoa's valuable forest resources.

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News from USP GIS Unit

Nick Rollings, USP

The GIS Unit welcomed 2 new staff members in October. Dr Gennady Gienko has joined the Department of Geography in a new position as lecturer in GIS and remote sensing. Gennady has worked in academia for 12 years in photogrammetry, geodesy, cartography and remote sensing.

Dr Nick Rollings has joined as the new Director of the GIS unit and senior lecturer in GIS & remote sensing. Nick's a career in remote sensing and GIS starting in 1985 in mineral exploration. He has spent the last 2.5 years working in the Kowanyama Land and Natural Resources Management Office as their Spatial Information Systems Manager. Kowanyama is a remote Aboriginal community on the west coast of Cape York Peninsula in far north Queensland, Australia. Prior to that Nick was an academic for 13 years firstly at RMIT's Department of Land Information (now Dept Geospatial Science) and later at the University of New England's Department of Ecosystem Management. Nick's interests lie in the application of remote sensing and GIS to natural resources management and the development of desktop GIS applications.

The 2 new appointments, along with the familiar face of Conway Pene, brings the GIS Unit to a full complement of 3 staff. The new GIS Unit is looking forward to continuing its work with the GIS and remote sensing community of the region. We are particularly interested in the provision and support of teaching, research and project work that is appropriate for countries of the South Pacific. Our first initiative is to offer our current suite of GIS courses by Distance and Flexible Learning (DFL).

Anyone interested on contacting the GIS Unit can do so by visiting the website at

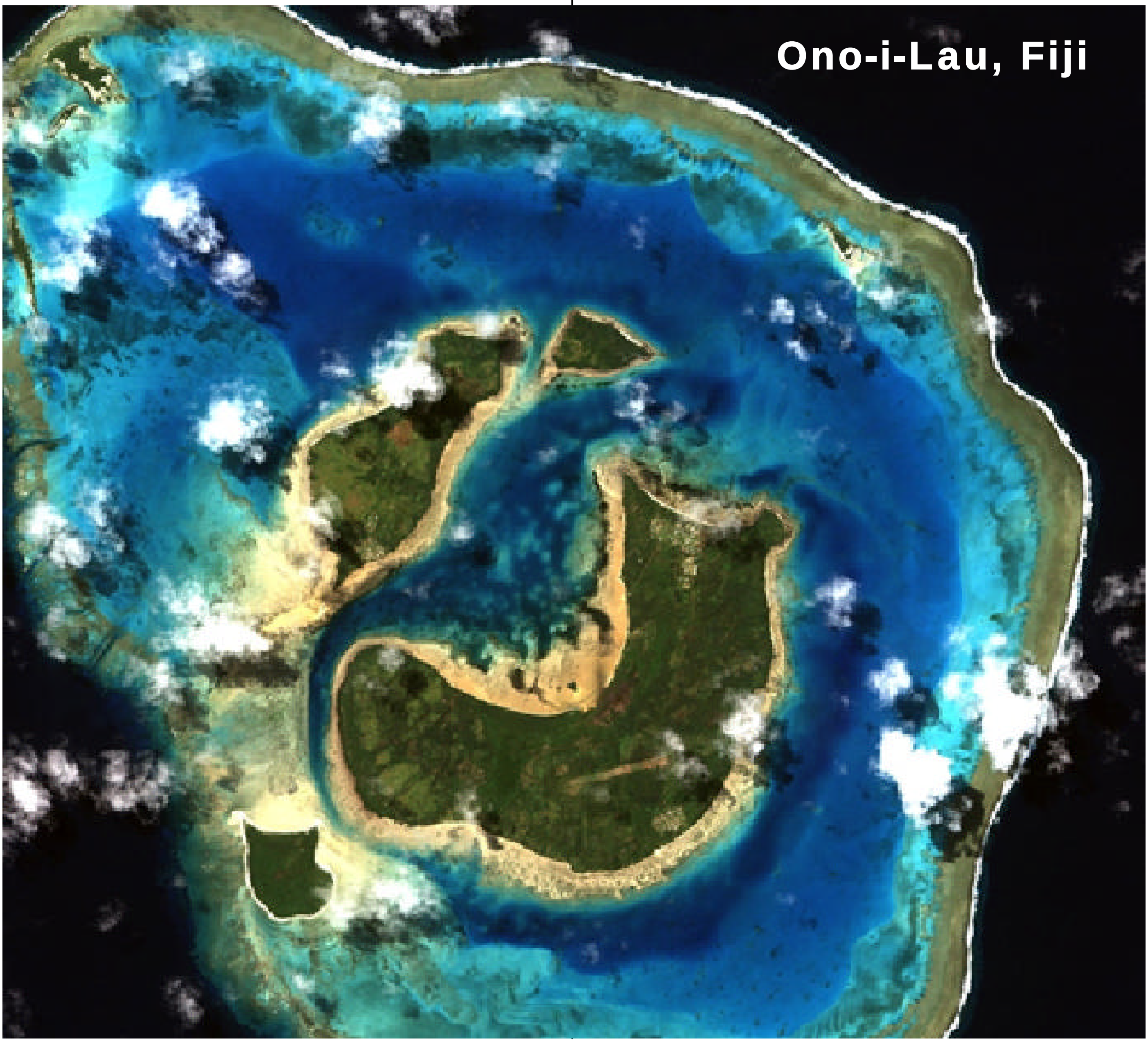
http://www.usp.ac.fj/gisunit/ or calling Nick Rollings on 679 321 2540

OrbView-3 Satellite is Recording High-Resolution Image Data

Wolf Forstreuter
SOPAC

ORBIMAGE's OrbView-3 satellite was launched, 26 June 2003. It is the third satellite providing high-resolution colour images of Pacific Island Countries. Like IKONOS, OrbView-3 produces one-meter resolution panchromatic (black&white) and four-meter resolution multi-spectral (colour) imagery within an 8 km swath. One-meter imagery enables the viewing of houses, automobiles and aircraft, and makes it possible to create highly precise digital maps and three-dimensional fly-through scenes. Four-meter multi-spectral imagery provides colour and infrared information to further map cities, rural areas, vegetation and undeveloped land from space.

The satellite revisits each location on Earth in less than three days with an ability to turn from side-to-side up to 45 degrees. OrbView-3 imagery can be down linked in real-time to ground stations located around the world or stored on-board the spacecraft and down linked to ORBIMAGE's master U.S. ground stations. However, Pacific Island Countries are outside the footprint of any ground station and must relay on the on-board storage facilities.



Ono-i-Lau, Fiji, (image right)

This multi-spectral image of Ono-i-Lau, one of the 322 islands of the Fiji archipelago, was collected by ORBIMAGE's OrbView-3 satellite on Thursday, May 13, 2004. This atoll comprisis six main islands - eroded remnants of an old volcanic crater. Ono-i-lau is approximately 7.9 sq. km in size, with a shoreline that is 99 percent coral reef.

Mobile Satellite Image Ground Station for Pacific Island Countries?

Wolf Forstreuter

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Figure 1: *Ground station in Munich, Germany. Such a ground receiving station allows utilisation of the satellite sensors during every over flight and allows last minute programming of areas to be recorded dependent on cloud cover.*

Pacific Island Countries are outside the footprint of any ground antenna that can receive image data providing a special resolution usable for mapping at 1:50,000 or 1:10,000 scales. Space-borne images used so far in the Pacific have been stored on onboard tape devices or transferred via relay satellites to ground receiving stations in USA.

European Space Imaging, a company distributing IKONOS image data, is using a transportable ground receiving station housed in two shipping containers that controls the satellite during the over flight. Such a mobile station could also be temporaril placed in the Pacific where it would be possible to receive images directly during the over flight. This has two advantages:

1. Pacific Island Countries do not depend on the onboard tape capacity, which is mostly booked out, as IKONOS data are also used for military purpose and there is a huge demand to record data all over the world. The data recording could be used nearly every day when the satellite is in the area of the ground antenna.
2. The IKONOS satellite is able to move and look sideways. The target areas to be recorded can be programmed up to a few minutes before the satellite enters the Pacific region and having the latest satellite weather images from the geostationary satellites the tasking controller can optimise the recording.

This would enable the acquisition of more cloud free and timely images that can serve many applications that could include vessel monitoring, post disaster analysis and critical resource inventories.

After sufficient image recording from the region, the station could be moved to other areas and the station would be returned when new images are required.

The temporary installation could be financially viable if all Pacific Island Countries agree to jointly purchase the image data.

Figure 2: *IKONOS satellite over the Pacific. The user has to book on-board storage facilities in advance and the user has to wait until the data is preprocessed and shipped to the Pacific Island Countries.*

GIS as a Planning Support Tool for Community Integrated Tourism Development

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Introduction

In the South Pacific region many countries are embracing tourism as a vehicle for social and economic development. Experiences of governments hosting tourism development in the region have, however, raised questions about the long term sustainability of mainstream tourism development in terms of environment, society and economy. In recent years attempts to foster alternative models of tourism development are being embraced, mostly labelled as 'eco-tourism' or 'community-based tourism', to deliver development benefits more widely and more directly than mainstream mass tourism.

At present, tourism planning and development occurs through a variety of government agencies and various administrative processes. These agencies require a diversity of social, economic, landscape, environmental and community data, in order to assess and facilitate the development process. However, much of the data used in this process is collected and maintained in different agencies and in different forms, and the collection and integration of this data continues to be a major challenge in the development process. Also, this institutional data often does not reflect the local community's perception and use of the landscape. For example land parcels and other administrative boundaries do not show local community resources such as sources of firewood, shellfish gathering sites, and seasonal fruit trees. Similarly, socially significant sites such as burial grounds and abandoned village sites are not included in formal, institutional data used in the tourism development process.

This project was designed to study how GIS could be used to integrate institutional data with local community data, to be used a planning support tool, in the context of an area earmarked for a major tourism development.

Project background

In 2002 the Japan International Cooperation Agency (JICA) established a grant at the University of the South Pacific (USP) to fund research in to the Information and Communication Technology. In 2003 the Department of Tourism and the GIS Unit received funding from this grant to undertake a study in to the use of GIS as a planning support tool for community integrated tourism development. The study took place over 2003 and 2004, in the Momi Bay area of south-western Viti Levu, which is being developed in to a large scale resort complex and golf course. Throughout the project, the researchers worked closely with the Ministry of Tourism and the Fiji Tourism Resources Owners Association.

Project data

The data collection stage of the project was divided in to 2 main areas. Firstly, institutional data was collected from a variety of government agencies, including the Fiji Land Information System, the Native Lands and Fisheries Commission, the Native Lands Trust Board and the Public Works Department, and Architect Pacific (the project developers for the resort site). This data was collected and managed in ESRI ArcView GIS.

The main data sets collected were:

- the cadastral base, showing surveyed land boundaries
- the topographic base layers from the 1:50000 topographic map sheets
- traditional land ownership boundaries
- infrastructure, particularly roads

An air photo mosaic of the area was also created, using air photos from the Department of Lands and Survey's Air Survey Unit.

The second stage in the data collection process was to collect data from the local community. This took the form of workshops held in the villages around the

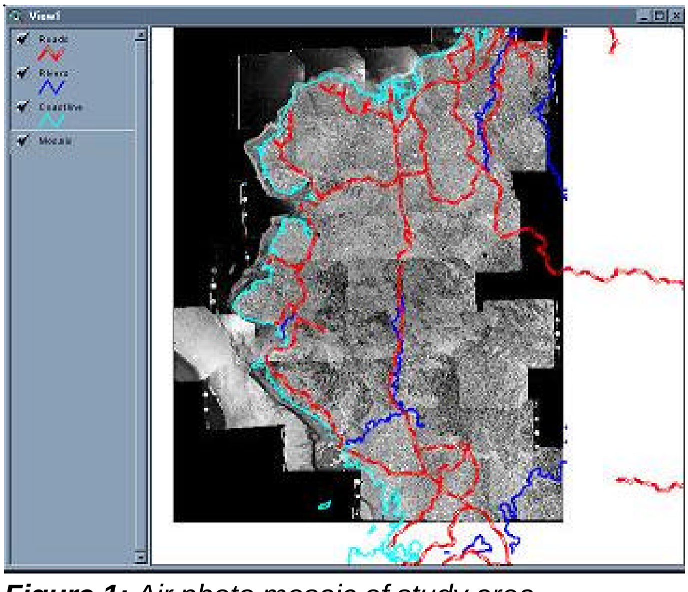


Figure 1: *Air photo mosaic of study area*

GIS as a Planning Support Tool for Community Integrated Tourism

Figure 2: *Hotel development site*

project site, where members of the community sketched a variety of sites of social and cultural significance on to enlarged air photos of the area. These sketch maps were then verified by going out to the sites with some of the community members and mapping the sites with a handheld GPS.

The data collected from the communities included resource sites such as plantations, sources of firewood, fishing grounds, and medicinal plants. Social and cultural sites such as burial grounds, *tabu* areas, old village sites and traditional fortifications were also mapped.

Results

The combined institutional and community data showed a rich and diverse landscape, which is not normally reflected in the institutional data alone. This combined data set was compiled on a CD, with a data viewer (the freely available ArcExplorer), and distributed to the various agencies involved in the tourism planning and development process. An ongoing aim of the project is to put the necessary resources in place in the communities, for this data to be available to the community, and for the community

Figure 3: *Results of community mapping workshop added to the map*

to be able to take ownership of the data and to update it. While this is beyond the scope of this project, some of the other stakeholders have shown and interest in supporting this. To facilitate this transfer of control over the data to the local community, computers and software would need to be made available, together with suitable training. Also, it would need to be coordinate and supported by some sponsor agency, at least in the initial stages of such a venture.

This project has demonstrated that local community data can be collected and integrated with existing institutional data and utilised a planning support tool. The relatively low level of technical sophistication, means that this methodology can be easily replicated, and is an important step towards greater community participation in development planning.

Deployment of MapServers.. .cont'd from page 5

shows the seabed allowing the detection sea mounts close to the shore. These from seamounts as an example usually show good fishing grounds. To make these maps, we use a survey vessel affixed with a swath mapper. It took about a month to survey the south coast of Fiji and another couple of months to process the data.

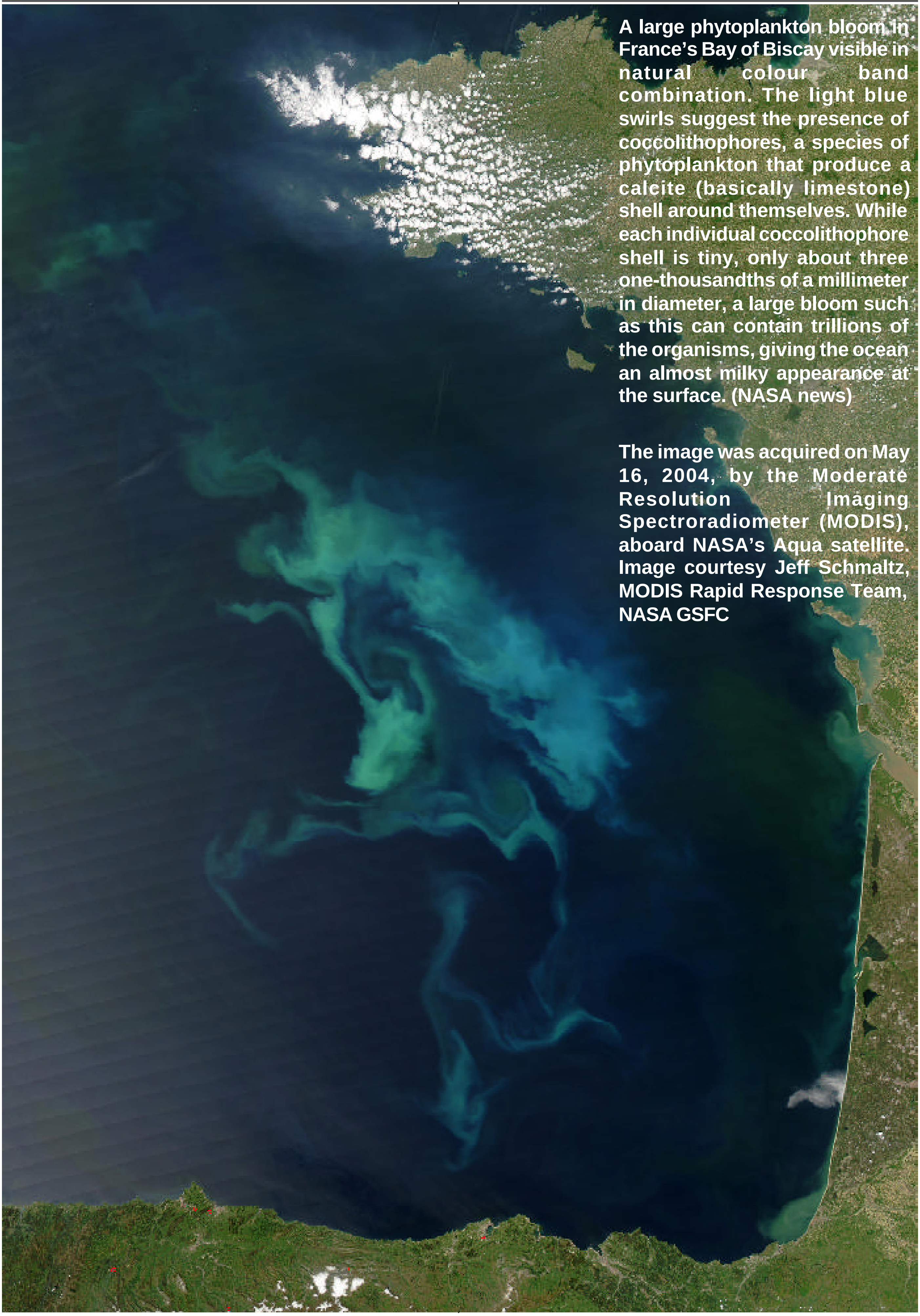
What is interesting on the Mapservers?

In Fiji the sea floor elevation from Suva to Momi has been publshed. This is a wide area used in game fishing, tourism, diving and local fishing. The Native Land Commission boundaries are also online for the whole of Fiji, merged with Soil and Forest Types, they provide interesting information. In Tonga, the sea floor around Tongatapu is available. The whole cadastral of Tongatapu can be queried. Kiribati has published the land use information for Tarawa. Tuvalu has published detailed maps for each of its 9 islands with high-resolution satellite imagery and sea floor mapping. Vanuatu has transferred most of the layers from VANRIS to the MapServer allowing the population at large to consult them without having to acquire MS-Access or MapInfo. Finally Papua New Guinea has been publishing exploration licences maps.

The Future is even brighter

More layers will be added with more information on the geography of the countries, which could be used by schools to find local information. We are also working in making the interface even more user friendly and adding dynamic layers showing the cloud coverage, the current cyclones, earthquake and other daily information.

MODIS records phytoplankton blooming



A large phytoplankton bloom in France's Bay of Biscay visible in natural colour band combination. The light blue swirls suggest the presence of coccolithophores, a species of phytoplankton that produce a calcite (basically limestone) shell around themselves. While each individual coccolithophore shell is tiny, only about three one-thousandths of a millimeter in diameter, a large bloom such as this can contain trillions of the organisms, giving the ocean an almost milky appearance at the surface. (NASA news)

The image was acquired on May 16, 2004, by the Moderate Resolution Imaging Spectroradiometer (MODIS), aboard NASA's Aqua satellite. Image courtesy Jeff Schmaltz, MODIS Rapid Response Team, NASA GSFC