The Newsletter of the GIS&RS Users in the Pacific

Pacific Islands

GIS&RS NEWSLETTER

INSIDE

The Pacific Islands GIS&RS User Conference 2012, Greater than ever before

The Pacific Islands GIS&RS User Conference took place from 27th November to 30th November 2012 at Holiday Inn in Suva. The theme "Mapping Pacific Resources" covered the new mapping approaches of forest, agriculture vegetation, coconut and other types of land cover. More than 350 people registered and more than 200 people actually appeared at the Conference. These are more participants this conference had ever before. Technical presentations about different GIS application were given by GIS officers from Kiribati, New Caledonia, Papua New Guinea, Samoa, Tonga, Vanuatu and also from Australia, New Zealand, Canada and USA.

The new newsletter team is in contact with most of the presenters and will publish during the year articles covering the different thematic areas for which presentations were given during the three and a half days. We still have not solved the finances and technical issues to print the newsletter like in the years before and for the time being this newsletter will only be available for download from SOPAC and the conference website.

We as new team would like to receive especially articles from Pacific Island Countries and hope that to activate this sprit again to fully re-establish this Pacific GIS and RS publication.

Maximize Your Investment with Topographic Mapping Revolution
Peter Kinne

The World As We Knew It

Topographic (Topo) mapping has traditionally been a laborious process. Several countries across the globe have topographic maps that have not been updated in decades, but need to be, in order to catch up with the developed nations. It is indisputable that, historically, it has taken millions of dollars and multiple decades to create acceptable topo maps. But even as the maps are being developed, they are already perversely out-of-date, so the financial investment and the value of that investment are completely misaligned.

DigitalGlobe, USA has invested in the technical ability and developed a proven performance record toward reducing costs, timelines, and improves the accuracy with nationwide collection capabilities. This technology allows end-users to extend both the life and value of an initial investment by leveraging this advanced technology to update maps. For example, DigitalGlobe is currently working on a large nationwide mapping project for a major national government in South America where 1:25000 scale maps will be delivered at a fraction of the cost from just a few years ago and the end user can seamlessly and cost effectively leverage their initial investment toward 1:10000 scale maps as their needs change.
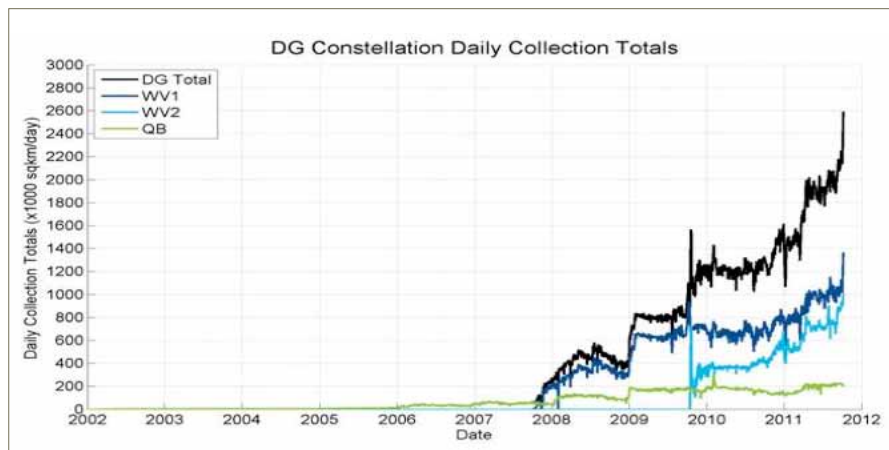
The Worldview Revolution As We Know It

DigitalGlobe has pioneered the launch of next generation, high-resolution, earth observation satellites that are changing the paradigm of traditional mapping. The launch of their WorldView-1 satellite resulted in unprecedented collection capacity, covering large areas of the globe frequently. Today, WorldView-1 is capable of collecting over 1.2 million km^2 of panchromatic imagery every day or almost 3 times the land mass of the earth every year. Now adding on the collection capabilities of WorldView-2, the DigitalGlobe constellation has the ability to collect over 2.4 million km^2 of 50 centimeter or better resolution imagery, every day. Furthermore, WorldView satellites are designed with agility in mind, allowing collection of stereo imagery that can be used to produce high-accuracy elevation models. The figure below shows the coverage of the constellation over the past decade.

DigitalGlobe has also developed the capability to produce large area elevation models to support nationwide mapping as well as creation of contours.

Traditional Topographic Mapping Vs Worldview Topographic Mapping

Traditional topographic mapping techniques include surveying techniques coupled with geodetic networks to create topographic sheets of large areas. WorldView satellites bring a new approach that complements traditional surveying and allows creation of country-wide topo sheets economically with faster turnaround times. Typical accuracies of orthorectified images produced from WorldView satellite imagery are in the 6 – 8 meter range globally, with exceptions in steep terrain areas. Additionally, DigitalGlobe has developed technologies that can leverage satellite imagery from other satellites including government-owned satellites as well as other commercial satellites, to produce country wide orthomosaics.

There is 2.9 billion km^2 of imagery of the world in the DigitalGlobe imagery archive, which is growing rapidly every day. This archive has existing stereo coverage of large areas that can be exploited to create elevation models and contours for topographic maps.

Transforming Pixels to Topographic Maps

Focusing on three critical aspects for transforming pixels into topographic sheets, accuracy, age, and quality, DigitalGlobe is uniquely advancing this topographical mapping revolution. They are continually working to improve positional accuracy of their satellites as well as developing technologies to improve their overall orthomosaic accuracy. Through a strategic content plan that uses a combination of metrics, including global population metrics, city extents, etc., DigitalGlobe strives to ensure the age of new orthomosaics is as current as possible. Additionally, state-of-the-art, in-house processing techniques allow DigitalGlobe to create high quality, visually pleasing mosaics.

Several image processing challenges have been successfully addressed by DigitalGlobe such as large area bundle adjustment, radiometric balancing

over large regions, and the need for ground control points.. DigitalGlobe has developed a unique technique that minimizes the need for ground control points. This breakthrough technology will result in significant cost savings for the customers as well as faster turnaround times for creation of large area orthomosaics.
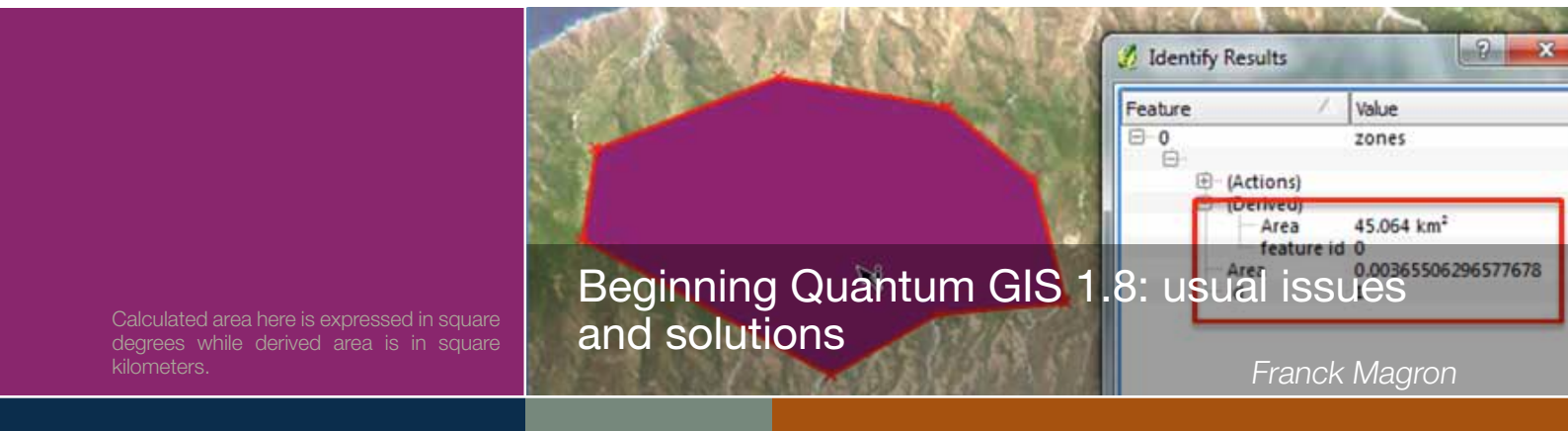
DigitalGlobe understands the value of authoritative data. We have developed strategic relationships across the globe that allow us to work with local sources such as survey departments to ensure that end products conform to requirements of the local country.

Changing the Paradigm of Traditional Mapping

DigitalGlobe's Earth Observation satellites and image processing technologies are making new

mapping techniques more effective and economical. This enables our customers to do countrywide mapping at 1:10000 scale or better with even better accuracies (scales up to 1:5000 or better), on cities and urban areas, with ground control. DigitalGlobe is actively engaged in nationwide mapping for select countries across the globe. As geospatial technology becomes more interwoven with the fabric of day to day life, DigitalGlobe is establishing itself as a leader in this geospatial evolution/revolution.

In summary, DigitalGlobe solutions act to effectively facilitate the timely building and maintenance of topo maps in a cost effective manner. This makes topo maps a reality for all countries and particularly those that are challenged by time and financial resources.

Calculated area here is expressed in square degrees while derived area is in square kilometers.

Beginning Quantum GIS 1.8: usual issues and solutions

Franck Magron

In most Pacific countries fisheries departments the use of GIS increases gradually as often several fisheries officers have had a previous experience with some GIS software and sometimes still use some. Yet because of cost and licensing issues, the availability of commercial GIS software is often limited to a few desktop positions and the use of GIS is not widespread within the office despite its usefulness for marine resource assessments and aquaculture farms monitoring.
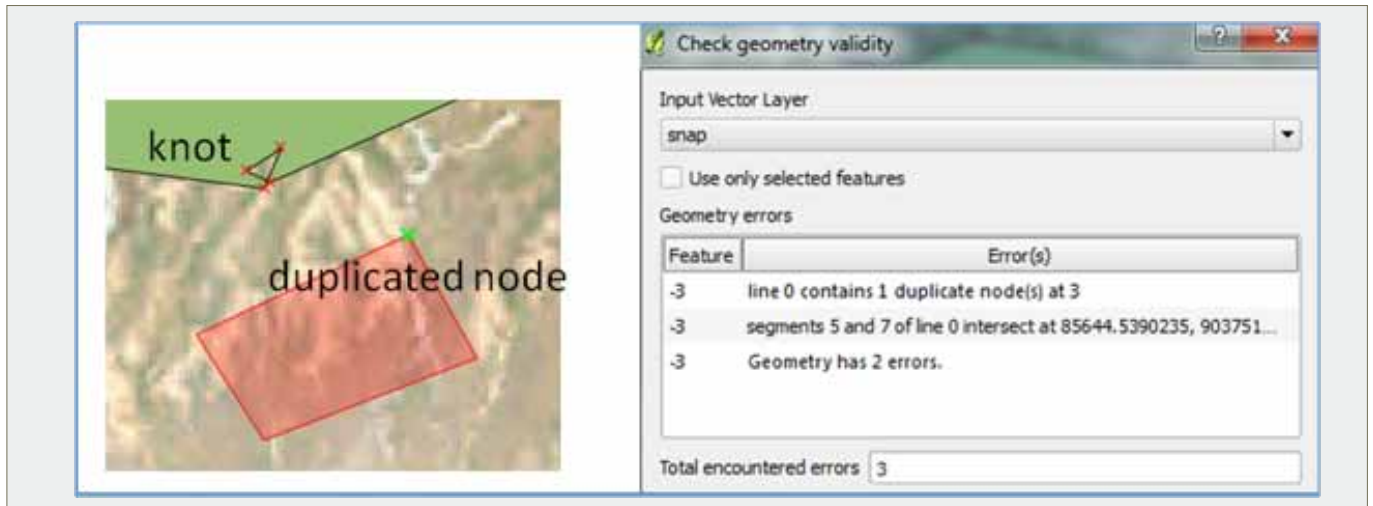
Several open-source applications were envisaged to complement the existing

software and broaden the use of GIS by fisheries officers and QGIS 1.8 was chosen because its relative ease of use, its available features and an active developer community who constantly improves and maintains the software.

In 2012, SPC Coastal Fisheries Programme conducted on-the-job QGIS trainings for marine resource assessment and management in several Pacific countries as part of the EU funded SciCOFish project. Training sessions were customized to use existing country survey data and satellite imagery, highlighting the

usefulness of GIS for survey planning and habitat mapping prior to the field work as well as to display survey data analysis and calculate areas for stock estimation. Various activities were conducted, ranging from overlaying bubble maps and pie charts on top of satellite imagery to more advanced activities such as delineation of zones and use of geoprocessing tools to manipulate polygons and calculate habitat areas.

We observed that most trainees were facing common issues which they struggle to solve without the active

Common geometric errors

help of the trainer and which would probably prevent fisheries officers to conduct similar tasks once by themselves. Because these issues are blocking the user from progressing, they require emphasis during trainings so that we ensure the future users won't be discouraged while exploring QGIS and will benefit quickly from use of QGIS for their daily tasks.

Several issues are related to the choice of the project projection and the simultaneous display of layers in different projections:

- On-the-fly reprojection is not enabled and therefore some layers are not showing up

- QGIS sometimes crashes when enabling on-the-fly projection for a UTM raster that overlaps the date line

- For a long-lat GCS layer, the unit is degree for scale bar and square degree for areas. For UTM layers on contrary, the unit is meter.

These issues can be solved changing the default settings, carefully choosing the project & layer projections (UTM or long-lat) according to desired outputs, and using geometry columns in addition to $area calculated columns to determine polygon areas in square kilometers.

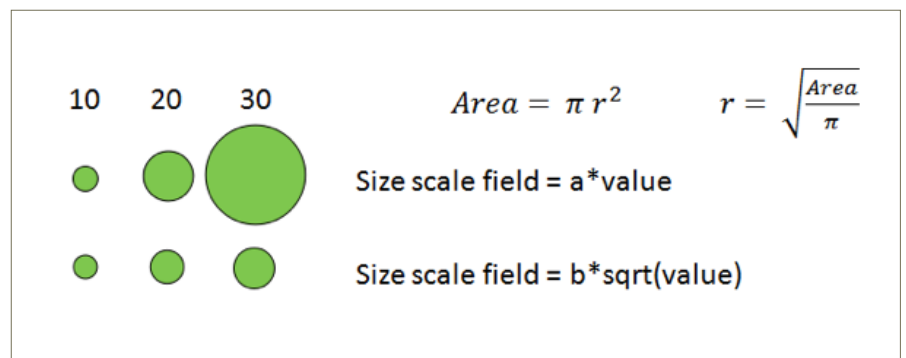We found also that due to differences of behavior between QGIS and MapInfo (polygon closed with the right click instead of a double click), former MapInfo users were likely to produce polygons with geometric errors (duplicate nodes and knots) when delineating zones. Users must be trained to detect and correct geometric errors especially they must be aware that geometric errors can possibly cause geoprocessing errors not always easy to interpret at later stage.

Finally fisheries officers were shown how to produce bubble maps to display survey data. From layer properties, it is possible to make the size of the chosen symbol proportional to a field value. The trick is that for a round shape (disk), the size corresponds to the radius of the disk, and thus its area increases proportionally to the square of the value, which provides a wrong visual clue. We are more familiar with bubble representations where the disk area (not radius) increases linearly to

the value (and therefore the size must be proportional to the square root of the value).

Calculation of the square root of the field value must either be done before the importation into QGIS or by adding a calculated field to the layer. The later method is more flexible but some users faced difficulties due to shapefile limitation on field names (no more than 10 characters) and data type (decimal number for which the precision must be set).

For most coastal fisheries applications QGIS provides all the features needed on a daily basis by coastal fisheries officers and we will continue to promote QGIS for coastal fisheries. Because most beginners faced blocking issues, training sessions must concentrate on these issues to provide solutions, tips and workarounds.

$$Area = \pi\, r^2 \qquad r = \sqrt{\frac{Area}{\pi}}$$

Size scale field = a*value

Size scale field = b*sqrt(value)
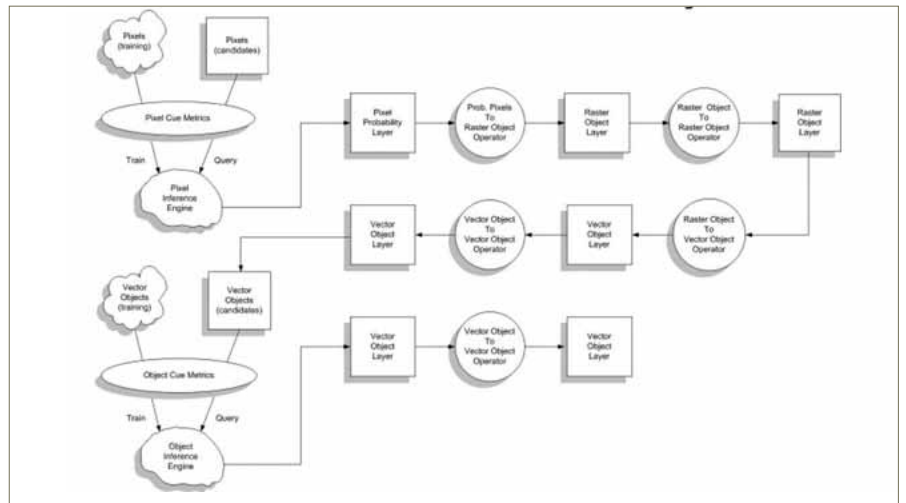
Disk size scaled by field value

Automated Workflow to Create Information from Images

Michael Ann Lane

Generating and maintaining geospatial information layers is time consuming and costly due to its manual nature. Satellite imagery, aerial photography, and LiDAR data can provide effective ways to collect this information. Image classification and feature extraction technologies can assist in rapidly providing information layers derived from recent imagery and elevation data. There is a need for up to date information that can be produced quickly, efficiently, and at a lower cost than manually collecting features via techniques like "heads-up" digitizing. Automated feature extraction algorithms allow users to construct models to extract feature(s) of interest from imagery. Primary examples include but are not limited to automatically extracting building rooftop footprints, roads, swimming pools, streams, manhole covers, light posts, airplanes, multi-class vegetation classifications, and even change detections between datasets acquired at different dates such as building height change during construction or destruction after a manmade or natural disaster. Once developed, a localized automated feature extraction model can be utilized for much larger areas of coverage, can be batch processed across multiple CPUs or distributed across networks, and can also be used to extract features from other imagery in different geographic locations. These factors contribute to time and cost savings compared to manually collecting geospatial information layers. Turning imagery into actionable information remains the key reason for collecting and exploiting remotely sensed data.

The purpose of the design of the IMAGINE Objective framework is to automate the process of feature

extraction from imagery. The foundation of this design is modelled after the human visual system for image interpretation. This is accomplished by quantifying all the salient visual image interpretation cues for a feature, training machine learning components with these cues, then processing the imagery in a manner that these learned cues can be applied.

The field of image interpretation has determined the cues used by a human for manual image interpretation are: color/tone, texture, size, shape, shadow, site/situation, pattern, and, association. For these cues to be employed in an automated IMAGINE Objective system they must first be quantifiable. This quantification of the cues is achieved with cue algorithms that yield cue metrics that make them usable in this context. However, this requires understanding the information these cues are measuring and that they necessarily fall into two distinct categories: pixel level cues and object level cues. Pixel level cues must be dimensionless, that is, measurable as pixel values. Object level cues measure properties of one dimensional lines

or two dimensional polygons. They can also measure relationships of an object's distributional patterns within a feature class or feature objects spatial association with other feature objects.
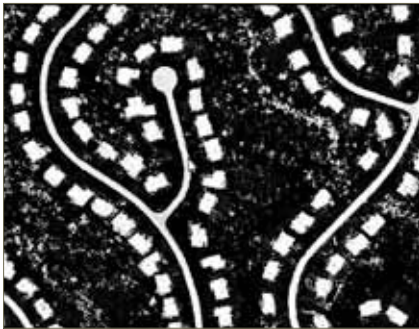
So in order for a system to exploit all the human interpretation cues it must have two separate machine learning components capable of training, learning, and querying for cues at each of the two cue levels. Additionally, the process must provide the capability to transition information between the levels, specifically from the pixel level to the object level in order for these cues to work together in one system.

Pixel Classifier

Classifiers are the machine learning components to the process. To make the system adaptable to different feature types as well as to compare the performance of different machine learning algorithms the Pixel Classifier is implemented as a plug-in (DLL). For a machine learning algorithm to be suitable for this process it must be able to handle both continuous and
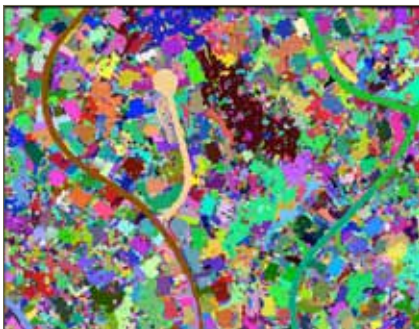
discrete variables, learn from training samples, and return a query metric for candidate pixels indicating a goodness of match to the training samples. Suitable machine learning algorithms identified thus far include: Bayesian Networks (BNs), Classification and Regression Trees (CARTs), and Neural Networks (NNs).

Pixel Probability Layer

The output of the Pixel Classifier is a Pixel Probability Layer in which each pixel's value represents the probability that it is the feature of interest. This layer becomes the starting point for several operators that can perform in the raster domain, convert to the vector domain, and further operate in the vector domain. These operators translate the information in the Pixel Probability Layer into vector objects or vector object attributes that are used in all downstream processing.

Probability Pixels To Raster Objects Operator

This operator converts the Pixel Probability Layer into a Raster Object Layer. This output layer contains pixels that are grouped as raster objects. A raster object is a collection of pixels that touch each other (either using a 4 or 8 neighbour rule) and are discontinuous

to the other raster objects. The pixels in these raster objects share a common class ID and also have an attribute table. For each raster object, the zonal mean probability from the Pixel Probability Layer is computed and stored as an attribute. This is the starting probability value for the object. To make the system adaptable to different feature types these operators are implemented as plug-ins (DLLS). An example is segmentation. To segment an image means to divide it into geometric primitives. While not necessarily derived from the Pixel Probability Layer, the raster object segments will have the zonal mean pixel probabilities as attributes.

*IMAGINE Objective now offers the Full Lambada Schedule (FLS) Image Segmentation. It is an iterative segment merging algorithm that begins with a trivial segmentation (one segment per pixel), merges with the adjacent segment pair with the Minimum Cost function, updates the minimum cost function for all neighbouring segment pairs adjacent to the merged pair and continues merging until all remaining segment pairs have a cost function value that is less than a threshold value.

*Robinson, D.J., Redding, N.J., and Crisp, D. J. (2002) Implementation of a Fast Algorithm for Segmenting SAR Imagery, Scientific and Technical Report, 01 January 2002. Australia: Defense Science and Technology Organization.

Raster Object Layer

The output from the Probability Pixels to Raster Objects Operator contains pixels that are grouped as raster objects which have associated probability attributes.

Raster Object to Raster Object Operator

This class of operators takes the Raster Object Layer from the previous operation and performs mathematical morphology on the objects in the raster domain. The output is a new Raster Object Layer. This operator is optional to the process and may also

be chained in sequence with other operators in this class. To make the system adaptable to different feature types these operators are implemented as plug-ins (DLLS).

Raster Object Layer

The output from the Raster Object to Raster Object Operator contains pixels that are grouped as raster objects which have associated probability metrics.

Raster Object To Vector Object Operator

This class of operators converts objects from the raster domain to the vector domain. They take as input the Raster Object Layer from the previous step and convert each raster object into a vector object, normally a polygon or polyline, and then produce a Vector Object Layer. The rest of the process

flow will deal with these vector objects. To make the system adaptable to different feature types these operators are implemented as plug-ins (DLLS).

Vector Object Layer

The output from the Raster Object to Vector Object Operator contains the vector objects in a layer, such as an ESRI Shapefile. These vector objects will either be polygons or polylines depending on the nature of the feature they represent. They will also have the probability attribute associated with the raster object.

Input Vector Object Operator

This class operates on an input Vector Object Layer, performs operations on the vector objects, and produces a new Vector Object Layer. These operations may be necessary to change the shape of the vector objects by generalizing, smoothing, and so forth. This operator is optional to the process and may also be chained in sequence with other operators in this class. To make the system adaptable to different feature types these operators are implemented as plug-ins (DLLS).

Vector Object Layer

The output from the Vector Object to Vector Object Operator contains the vector objects in a layer.

Training and Candidate Vector Objects

During the training phase vector objects that are representative of the feature of interest may be submitted to

compute Object Cue Metrics to train the Object Classifier. These training objects are normally identified by the user with training polygons in the imagery or from template in a template library. One difference between pixel training and object training is that with object training the data will usually be sparse, that is, not enough examples to learn from. For this reason object training can be specified with distribution parameters such as a mean and standard deviation.

Vector Object Layer are submitted to the Object Classifier for query to measure how closely they resemble the training objects (or fit the parametric distributions). Of course, objects processed during the extraction phase must also pass through the Object Cue Metrics calculation. The query result for an object will be recorded as an object attribute to be used in downstream processes.

Object Cue Metrics

As previously mentioned, cue algorithms quantify human visual cues by computing cue metrics and the object level cues are computed on polygons and polylines. The cues that fall into this category are: shape, size, orientation, shadow, and background. These cue metrics are then used to populate the attributes of the objects on which they are computed. To make the system adaptable to different feature types these cues are implemented as plug-ins (DLLS).

Object Classifier

This class is the machine learning component for learning and querying object level properties. Like the Pixel

Classifier, the Object Classifier is implemented as a plug-in (DLL). It is not required that the Object Classifier implementation be the same as the Pixel Classifier. They may each use different implementations if available and appropriate.

Vector Object Layer

This object contains the same vector objects as the input layer to the Object Classifier query. However, the query results (probability metrics) now populate the attributes of the objects.

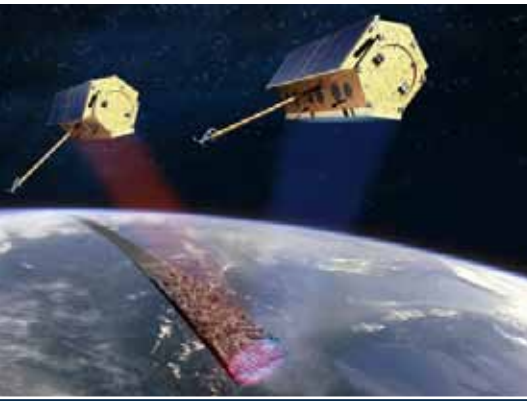## Output Vector Object Operator

These classes of operators are performed on the Vector Object Layer output from the Object Classifier query and are intended for probability thresholding and for cleanup of the object polygon or polyline footprint. To make the system adaptable to different feature types these operators are implemented as plug-ins (DLLS).

Vector Objects Layer

This output from the Vector Object to Vector Object Operator and contains the vector objects in a layer. This is the final result of the process. Along with the vector objects are the different probability metrics and cue algorithm metrics used in the process.

IMAGINE Objective uses the human visual system for image interpretation and therefore is able to mimic the capability we have to analyse data. Extracting information from imagery by using automated and semi-automated techniques can save time and money.

Name of programme: TERRASAR-X
Title: Artist's impression of the formation flight of TerraSAR-X / TanDEM-X
Caption: Artist's impression of the formation flight of TerraSAR-X / TanDEM-X
Copyright: © Astrium
Date photo taken: 30/04/2008
Reference: 090608-001

X-Band radar capabilities for the Asia-Pacific region

Noemie Bernede

Natural events and risks call for weather-independent remote sensing technologies and very high resolution X-band radar is particularly suited for many applications that provide a substantial socio-economic benefit such as mapping and monitoring landslides, floods, land subsidence or uplift.

Since more than five years, the TerraSAR-X mission has been recognised as a highly precise scientific and operational mission. In addition, together with its twin satellite TanDEM-X, a unique bistatic formation has been formed that is currently creating a global Digital Elevation Model (DEM) of unprecedented quality. This global DEM would be able to contribute to many monitoring initiatives in Pacific countries.

Based on recent research and evolving market needs, an operational improvement program has been set up for the TerraSAR-X:

- Near Real Time data access, now through the Svalbard polar station and later also thanks to the Inuvik station, providing instant access to all missions

- New imaging modes: aperture switching modes (in order to conduct Ground Moving Target Indication), very high resolution mode (Starring Spotlight) and new maritime ScanSAR Wide Swath are going to be implemented

- Improved revisit and increased capacity: collaboration with the Spanish PAZ mission, through a commercial agreement between Infoterra GmbH and Hisdesat, has

created a unique opportunity for a constellation with TerraSAR-X that will be capable of interferometric data takes supporting, among others, coherence change detection and surface movement measurements.

The improvements are expected to stimulate more research and market interest in preparation of the TerraSAR Next Generation and its very high resolution 25cm imaging mode and full polarimetric monitoring. This increased resolution, compared to the one provided for instance today by TerraSAR-X and TanDEM-X systems, will enable a new quality of high performance 4d-Earth observation services visualizing slow motions of landscapes, volcanoes, islands and even individual buildings and bridges. In the case of harbour monitoring for instance, examples in the Pacific (Suva harbour [ref]) show the current system capabilities to detect ships with a great precision. Nevertheless, with the very high resolution imaging mode, it will be possible to detect and identify on the imagery even very small boats, also if they are tied up together.

Today's radar satellites that could provide timely services are too limited in their resolution and it is necessary to extend the radar transmission bandwidth up of 1200 MHz, which should be realized in the 9-10GHz frequency range (X-band) allocated by the International Telecommunication Union (ITU) to the Earth-observation satellite service (EESS). To obtain the authorization to use this bandwidth, a process supported by a large number of countries interested in the potential

of radar applications, has been initiated for a decision at the World Radiocommunication Conference in 2015 (WRC-15). In this perspective, the ITU-R Working Party 7C has been assigned as the responsible group to study the options and prepare positions for the next Conference.

The administrations of the Pacific States, who have shown a great support, contribute to this process directly and through the regional Asia-Pacific Group (APG-15) Conference of the Asia-Pacific Telecommunity (APT). This long process, requiring a sustainable support in order to obtain an extension of the bandwidth, is the last opportunity to have very high resolution civil earth observation imagery worldwide.

Radar may be seen as the new kid on the block and a little bit more complex to use than optical images but the weather-independent capabilities and the precise measurements that can be made with radar can be very useful additional information sources.

Name of programme: TERRASAR-X
Title: TERRASAR-X - The German radar satellite TerraSAR-X
Copyright: © Astrium / 2006
Date photo taken: 02/06/2006
Reference: 060801-016

Without Planning there is Chaos

Kaliova Tunabuna

Role of the Department to the Government of the day

Overall Administration, Planning & Regulating of Land Use in Fiji through the: Town Planning Act cap. 140.

Responsibilities

Town Planning Schemes, Zoning & Rezoning, Master Plans, Subdivision of Lands, Engineering Land, Building Development, Policy Advice on Strategic Physical Planning and Land Use.

Urban Growth Map

Currently the Department is conducting a major Pilot Project on The Urban Growth Management Action Plan (UGMAP).The UGMAP for the Greater Western Region (GWR) is a major outcome of the joint Government of Fiji (GOF) and Asian Development Bank (ADB) Technical assistance.

This was built on the result of the Urban Policy Action Plan (UPAP).

Way Forward

- To complete Land Use Survey from Ba to Rakiraki
- Further Consultation with Stakeholders

Village Planning

The Department of Town and Country Planning is also undertaking the Urban Village Planning Scheme as part of the Urban Policy Action Plan (UPAP) and Urban Growth Management Plan (UGMAP). It's a United Nation Funded project.

Way Forward

- Further Consultation with Stakeholders
- 9 Village to complete for the Pilot Projects.

Method of Gathering Data

The team comprised of members from both the UGMAP GWC Project Team and the UGMAP Urban Village Project Team were divided into groups and were each given maps outlining their work schedule/timetable and specific work areas to be covered during the first phase of the survey from Namatakula, Sigatoka to Yalalevu, Ba. This also applies to the Zoning of Maumi Village.

Software & Tools Used

Arc Map Version 10, Arc Catalogue Version 10, Vanua View, Microsoft Office, Aerial Photographs, Town Planning Schemes, Base Maps, Cameras, Questionnaires, Pencils & Pen, Measuring Wheels.

The Editorial Team

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

Announcement

21–26 July 2013: IGARRS, Melbourne, Australia
Website: http://www.igarss2013.org

16–18 July 2013: IGNSS, Queensland, Australia
Website: http://www.ignss.org

19–21 August 2013: New Zealand Esri User Conference, SKYCITY, Auckland
Website: http://www.eagle.co.nz

25–29 November 2013: Pacific Island Countries GIS/RS User Conference, Suva, Fiji
Website: http://picgisrs.appspot.com

15–19 April 2013: Surveying and Spatial Sciences Conference, Canberra, Australia
Website: http://www.sssc2013.org