PACIFIC ISLANDS GIS&RS NEWSLETTER

Issue 1 - 2021 ISSN: 1562-4250

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Dear reader,

Over the past year, the pandemic has altered country priorities and some of our targets. Despite the challenges, the editorial team based in Fiji and Germany presses on to bring your anticipated GIS & RS highlights from and to the region.

We continue to work with our readers to spotlight the latest GIS and RS research and technologies relevant for the Pacific. This is the only publication, which focusses on spatial data applications in Pacific Island Countries. Screen the issues published on PGRSC's website www.picgisrs.org and reflect on how the story of GIS and Remote Sensing applications in the Pacific Islands has developed for nearly 30 years. This newsletter is an important documentation for continued knowledge sharing across our islands. The newsletter is an important documentation beside Facebook pages and other social media.

We kindly remind valued readers that all articles received are screened for relevance. We endeavour to publish all articles of Pacific Island applications especially those contributed by Pacific islanders. Expect more regional success stories in our next issue. So, happy reading and do feel to drop us a feedback or submit an article to be included in the next newsletter issue.

Content

Front page satellite image: image acquired Deimos Imaging

1. OSM Fiji: Building a Resilient OpenStreetMap Community

Carrol Chan, Fiji OSM Project Lead

After the successful running of the 2020 FOSS4G SoTM Oceania Conference at the Fiji Hub hosted at the University of the South Pacific in November, a small group of volunteers formed together to create OSM Fiji. As practitioners ourselves, we believe the value and utilisation of OSM data and open solutions is still relatively unknown here in Fiji however has the potential to grow. With intersectoral collaboration being recognised as a bottleneck for immediate geospatial analysis and decision making, the potential to improve OSM and open geospatial data for at least preliminary analytical use is a value many practitioners would recognise.

Through HOTOSM's Facebook Community Impact Microgrant we will be running a series of activities that includes open data socialisation, OSM mapathons and local community field mapping and verification. The underlying aim of these activities is to create an inclusive, vibrant, and active open geospatial community in Fiji that can sustain itself past the project grant end date. Currently, OSM Fiji is working on forging relationships with existing bodies and institutions such as the Pacific GIS and Remote Sensing Council of which an MOU has recently been signed; as well as The University of the South Pacific's Geospatial Science Programme and Flying Labs and SPC PCRAFI

project. Being able to link our objectives with existing bodies and institutions provides us with a wider platform in promoting open data and OSM and encourages broader participation.

On March 10-11th we kicked off our first open workshop in conjunction with SPC's PCRAFI project focused on open data socialisation for DRR using the Pacific Risk Information System and ran a half day mapathon contributing to the Ba district through HOTOSM Tasking Manager. The event had 28 participants and mostly comprised of female university students enrolled in the Geospatial Science programme at USP. We look forward to hosting more workshops in conjunction with organisational and institutional partners, with our next tech talk expected in April's Fiji GIS/RS User Group Meeting.

2. Uses of satellite-derived relative bathymetry and DEM data for disaster risk management: outputs from the CommonSensing project

Mathias Leidig and Richard Teeuw

School of the Environment, Geography & Geosciences, University of Portsmouth, UK.

1 1. Introduction

The CommonSensing project, funded by the UK Space Agency (https://www.commonsensing.org.uk/), has developed various satellite-derived datasets, covering all of the archipelago states of Fiji, Vanuatu and the Solomon Islands, to assist risk management via the mapping of geohazard zones, vulnerable features and exposed elements.

Globally the annual cost due to natural hazards has increased notably in recent decades, driven by pressures from growing populations, particularly in urban environments, as well as increases in the frequency and magnitude of climate-driven hazards (Tomás and Li, 2017). Small Island states often have limited financial and human resources to develop climate change resilience, and yet they are expected to face bigger changes in climate than mid-latitude countries (Schiermeier, 2018).

Improved decision-making for disaster risk reduction and climate change adaptation requires better knowledge to characterize, monitor and model geohazards and then mitigate their impacts on people and the environment (Pandian et al., 2018). Satellite remote sensing, also termed Earth Observation (EO), has been widely applied to disaster risk management at the preparedness, response and recovery stages. However, there still is a tendency to focus on disaster response (reactive approaches) rather than disaster preparedness (proactive approaches), with often little attention paid to post-disaster recovery and rehabilitation, such as the design of effective "build back better" strategies.

Many small island states in the Pacific have the additional challenge of many widely dispersed communities, e.g. for the partner countries of the CommonSensing project:

Fiji: 332 islands, 110 inhabited;

Solomon Islands: ca. 990 islands, ca. 300 inhabited;

Vanuatu: 83 islands, 65 inhabited (https://www.newworldencyclopedia.org)

Particularly important for coastal risk management

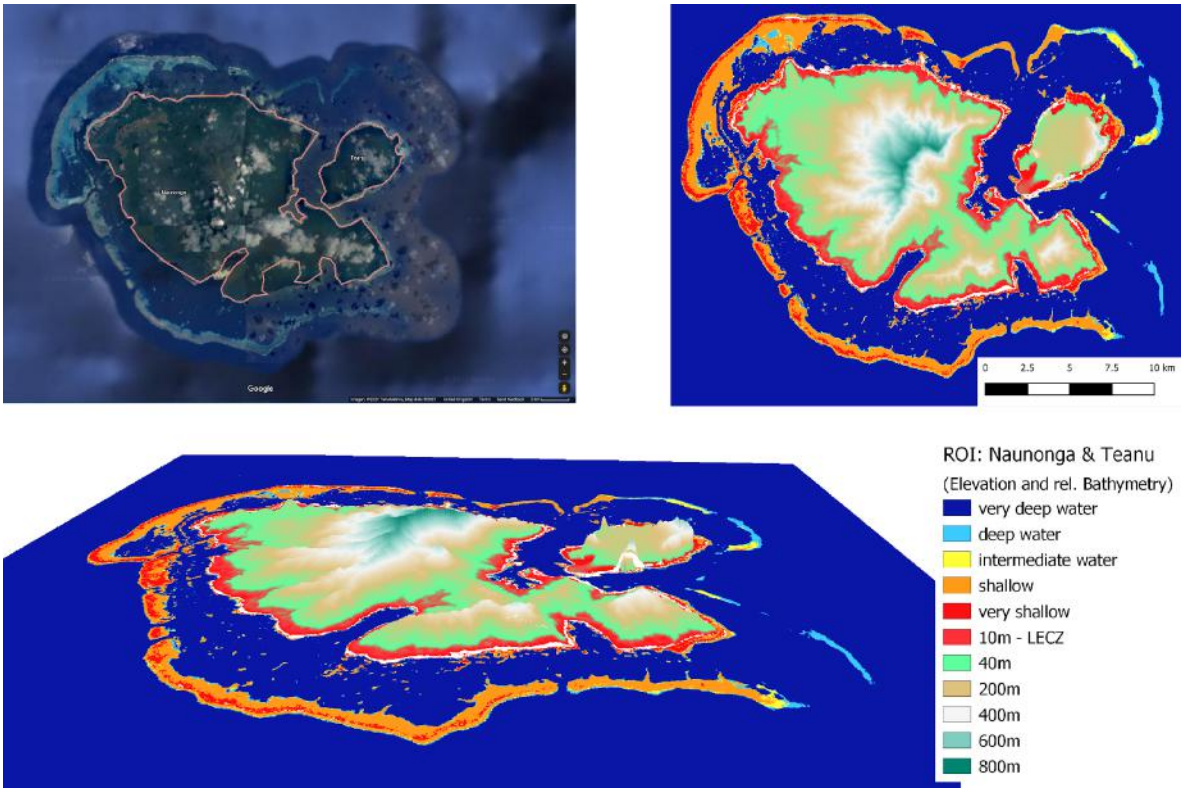

Figure 1: Example of the merged DEM and the relative bathymetry layer. Presented as an example here are the relatively small and remote Islands of Naunonga and Teanu (Solomon Islands).

considerations is the Low-Elevation Coastal Zone (LECZ): coastal areas with less than 10m elevation (McGranahan et al. 2007) and the nearshore bathymetry along the corresponding coastline.

2. Data

Archipelago-wide DEMs for Fiji, Vanuatu and the Solomon Islands have been produced from the 12.5m-pixel PALSAR DEM created by the Alaska Satellite Facility. Further nationwide mapping was applied to coastal relative bathymetry, down to approximately 30m depth, using Sentinel-2 imagery.

2 3. Applications

The satellite-derived relative bathymetry maps provide a useful indication of the potential exposure of coastal communities to marine hazards. The limited detail of these relative bathymetry maps makes them unsuitable for navigation purposes, but they are adequate for assessing the wave run-up hazard faced by coastal communities (Parente et al., 2018). If there are extensive coastal areas with shallow water and low gradients, then the run-up effects with storm surge waves or tsunami waves will be exacerbated. LECZs that have extended shallow coastal areas in front of them are even more at risk for coastal hazards, such as in storm surge or tsunami events, with associated flooding and erosion.

3 4. Satellite-derived sustainable geoinformatics for disaster risk management

The application of freely-available satellite-derived datasets, applying recent software developments, such

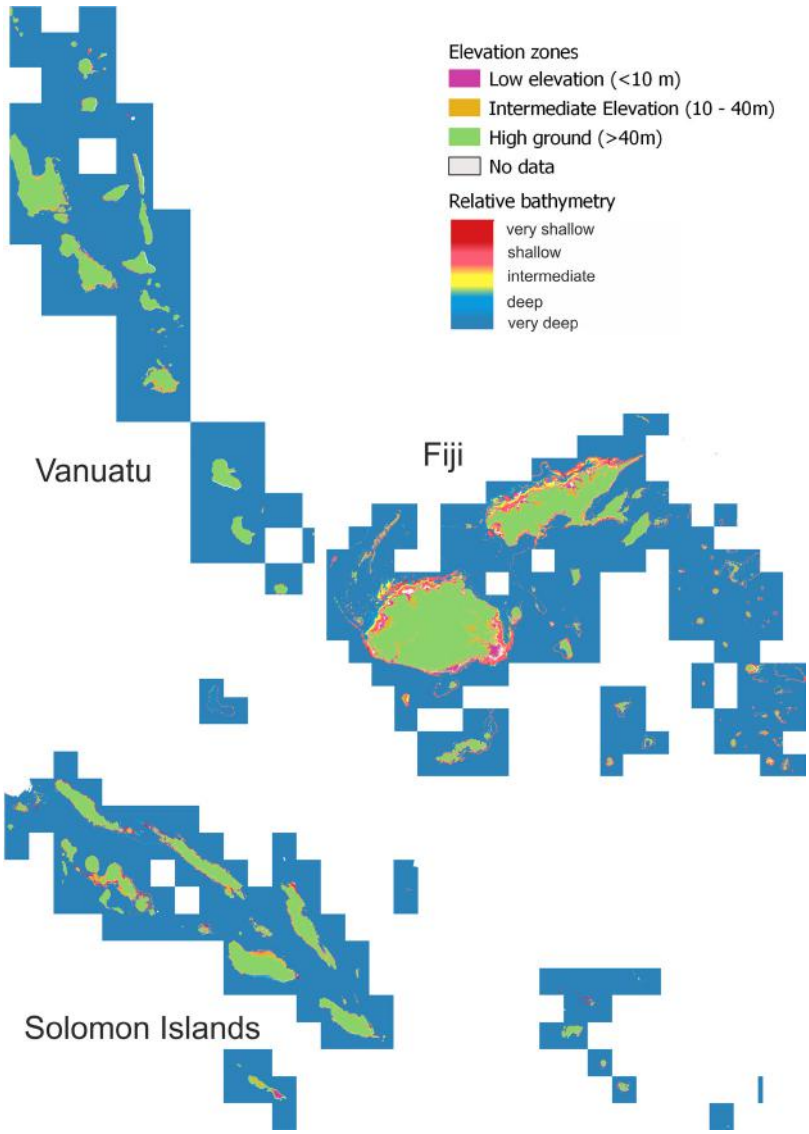

Figure 2: Overview of the coverage of the relative bathymetry and elevation zone layers for the CommonSensing countries: Fiji, Vanuatu and The Solomon Islands.

as Big Data analytics and Machine Learning, with Open Data Cube and Geoserver platforms, can provide essential map data to inform coastal risk analysis and disaster preparedness activities, even with regard to remote island communities. That can greatly assist climate change adaptation and disaster risk reduction initiatives, by highlighting geohazard prone zones, vulnerable features and high-risk locations, assisting decision-makers in the preparedness phase of emergency management by targeting often limited resources towards areas at greatest risk of coastal hazards.

Moreover, the approach and datasets presented facilitate the monitoring of urban growth, which may be in areas previously avoided for settlement because of geohazards, such as floodplains or zones of steep slopes. The datasets considered here are part of the CommonSensing data portals and will be freely available, potentially forming the basis for further land management applications in Fiji, Vanuatu and the Solomon Islands.

5. Free and Open data + free online geoinformatic training

Lack of geoinformatic expertise regarding GIS applications, particularly remote sensing (from image interpretation, through to data processing), is a potential limiting factor in the usage of CommonSensing satellite-derived datasets, despite them being freely available. Capacity development, via awareness raising and technical training, has therefore been a major feature of the CommonSensing project, led by the UN Institute of Training And Research (UNITAR). During 2020/2021 UNITAR, in conjunction with the University of Portsmouth, have run an online course on Geospatial Information Technologies for DRR (GIT4DRR, https://common-sensing.cern.ch/training/), building on earlier awareness-raising workshops, for Fiji, Vanuatu and the Solomon Islands.

6. Summary

An increasingly wide range of geoinformatic data and software is available for the mapping and monitoring of geohazard zones, vulnerable/exposed features and areas of risk. Unfortunately there is a major cost barrier: high-resolution satellite imagery - and the commercial GIS software to process that data - can each cost many thousands of dollars.

The CommonSensing project has used freely-available satellite imagery, with pixel sizes ranging from 10m to 30m, to map hazardous terrain and vulnerable features for the many hundreds of populated islands in Fiji, Vanuatu and the Solomon Islands. Particularly useful for coastal risk assessment are satellite-derived maps of the Low Elevation Coastal Zone and wave run-up hazard.

Free satellite imagery and derived map data is of little use without associated capacity development and technical training. Consequently the CommonSensing project has provided GIS users in partner countries with an online course on 'Geospatial Technologies for Disaster Risk Reduction', in which trainees access various freely-available geospatial datasets, processing them using geoinformatic freeware such as QGIS and SNAP.

7. References

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3. Satellite Knowledge is Power

Richard Dolamore and Lulu Phillips, Satellite Applications Catapult.

The IPP CommonSensing Project is a true celebration in international collaboration, bringing together partners from across the globe, focused on strengthening climate resilience in Fiji, Vanuatu and the Solomon Islands. With the aim of developing satellite-based technology to strengthen Pacific Islands' capacity to access Climate Finance, help strengthen national and regional climate action policies, reduce the impact of natural disasters with access to decision support applications and resources that impact these islands.

The ambitious CommonSensing Project began in 2018 and set out to create a resource service that uses satellite imaging technology processed into meaningful data to support the three countries. To use Earth Observation data and facilitate ease of access for the specified ministerial users, the solution that the CommonSensing Project pioneered was to process and host Analysis Ready Data (ARD) into an Open Data Cube (ODC) for these islands that could be used to produce data products that support use cases identified with local stakeholders. Along with the ESRI Enterprise Portal Solution for the Fijian Government users and an open source, TerriaJS/ GeoServer Portal Solution for Vanuata and Solomon Islands, the data developed during the CommonSensing Project can be discovered, viewed and used for climate and disaster resilience applications. Essentially, this means that the geospatial data user at a ministerial level, with minimal effort and technical expertise, can use a web-based portal service to access data archives of pre-processed data for further analysis and decision support over time.

The CommonSensing Solutions can be readily used as a decision support toolset to minimise exposure to risks associated with climate change. This enhances resilience and an ability to quantify these impacts financially, which empower these Pacific Islanders to help redress climate injustices.

As the Project moves towards the delivery phase, stakeholder training on the CommonSensing web-based platform has begun. The unprecedented cyclones experienced this last season and the ongoing Covid pandemic has tested the resolve of everyone involved in the CommonSensing Project. In particular, the severe

CommonSensing Climate Learning for Adaptation and Resilience Workshop delivered by UK Met Office in Port Villa, Vanuatu

travel restrictions have meant that bio and food security issues have prevailed over climate affairs. The Project has however continued unabated through all these ongoing challenges and is on course to be completed next month.

The training programmes in Fiji, Vanuatu and the Solomon Islands are being conducted both in-country and remotely. With the various partners delivering different components of the project, these training programmes cover an array of subject matter and recently have included CommonSensing Portal and Data Cube workshops, Met Office Climate Data training, Disaster Decision Support System and GIS and Remote Sensing trainings.

The feedback received from the training workshops has been encouraging despite the situation created by COVID-19. Attendees of the CommonSensing User Testing, commented that the apps are very relevant and applicable to the work they do on a daily basis. An official now using the system stated: “The applications work very well and helps in getting quick assessments done with relevant data on hand through parameter setting”.

The CommonSensing Project has created data, tools and training opportunities as well as relationships that will continue to move Pacific islanders in this target countries towards increased climate resilience; it has been an excellent example of effective international partnership in the face unprecedented challenges and satellite technology is empowering this resilience.

CommonSensing Earth Observation trainings for Climate Resilience and Disaster Risk Reduction

In partnership with the people of Fiji, Vanuatu and the Solomon Islands, the IPP CommonSensing Project is a cooperation between the United Nations Operational Satellite Applications programme (UNOSAT), the Satellite Applications Catapult, The Commonwealth Secretariat, Devex, The Met Office (United Kingdom), University of Portsmouth, Sensonomic and Spatial Days. It is funded through the UK Space Agency’s International Partnership Programme, part of the Global Challenges Research Fund.

Fiji participants attending the Advanced GIT and EO Training delivered by UNITAR-UNOSAT at the University of South Pacific, Suva

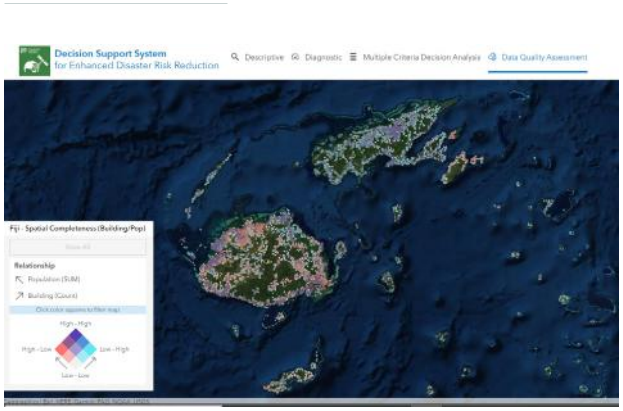
4. Fiji Missing Maps Mapathon

Leba Gaunavinaka (UNITAR-UNOSAT), Komal Devi (USP)

OpenStreetMap contains many geospatial datasets that are useful for Disaster Risk Planning, Disaster Risk Reduction and Disaster Management. The Fiji Building Outline Database is one such dataset and potentially holds all building outlines, building construction material and building functions. In 2018, the University of the South Pacific's Geospatial Science students undertook an assessment of the Fiji Building Outline Database on Open Street Map and confirmed substantial areas of Fiji has no building outline data.

UNITAR-UNOSAT together with the University of the South Pacific's Geospatial Science Programme facilitated a Fiji Missing Maps mapathon at USP, Suva on 26-28th August, 2019. USP's GS311 students will revisit these data in 2021 and add to the dataset. UNITAR-UNOSAT has since developed a tool that indicates where the building data is missing and interested mappers can compare this with their assessments and fill in the gaps.

More than ninety students, government officials and community mappers contributed to a rich baseline dataset using Missing Maps HOT Tasking Manager. Communities were also invited to contribute from their homes, libraries or school computer labs. UNOSAT brought an OSM expert



from the Humanitarian OpenStreetMap Team to deliver a Training of Trainers for future mapathon facilitators supported by UNSOAT and USP in country staff for the 2 day run-down. A layer of high resolution satellite imagery covering areas with coarse resolution on OSM was also availed to support this event.

Desktop verification and field validation was conducted using mobile applications such as OSM Collect and Maps Me. Future field surveys will be streamlined into USP's Geospatial courses, encouraging students to contribute and validate for humanitarian projects. Participants got practical experience in data capturing with Open Source tools raising awareness on the challenges of emergency operators and isolated communities fostering socially engaged citizens. We anticipate the trained mapping champions to replicate mapathons in future across other Pacific SIDS ensuring that updated information is expanded and shared through such collaborative mapping efforts.

5. 23 - 24 February 2021: The Pacific Islands Earth Observation Conference

The ***Intermediate Pacific GIS and Remote Sensing User Conference*** was held the 23rd and 24th of February 2021 organized by PGRSC (Pacific GIS and Remote Sensing Council). This unmissable annaul event inherits from a long history that began twenty-eight years earlier at the Fiji Forestry Department. Monthly meetings about good practices sharing, exchange of data and documentaiton, software assistance and networking emerges the first regional conference dedicated to geographic and spatial applications.

The objectives are to federate the whole GIS and Remote Sensing users' community of the Pacific in order to promote the exchange of know-how, promote innovations and advances in researches of interest for the region and transfer data, knowledge and new applications.

This event has become the main regional conference for both experts in these fields and users from different field of applications.

Held every last week of November, the 2020 annual conference in Port-Vila, Vanuatu, was postponed to November 2021 due to the current pandemic situation. The PGRSC therefore decides to organize a virtual Intermediate conference over 2 days. Thanks to the University of South Pacific, partner of the PGRSC, the conference was held from the Information, Communication and Technology Hub (ICT) of the USP Campus in Suva. ICT is linked to regional USP hubs in the Pacific (Samoa, Marshall Islands, Tonga, Vanuatu, Niue, Cook Island, Solomon Islands) allowing speakers and attendees from these countries to benefit from the USP Network to participate in this event. For the first time those GS professionals in more remote PIC's were able to access the conference. For example 5 GIS professionals from Niue were able to participate for the first time without travelling to Suva.

Salote Viti, Vice Chair of PGRSC steering the Conference

More than 150 people attend the scientific, technical or practical presentations during these two days of Conference. Opened by the Acting Vice-Chancellor and President of USP, Dr Masasso Paunga, thirty-six world-class presentations followed one another. The topics

Guests from different Suva based organisations followed the Conference 'life'

covered the wide range of technologies and applications of Earth Observation and GIS: from satellites to drone and Lidar, from artifical intelligence (AI) to mapping cultural narratives of the Pacific, from forests to lagoon turbidity. Major Space Agencies were represented (NASA, Copernicus, Planet, MAXAR), UN bodies (UNITAR, UN-SPIDER), the President International Society of Photogrammetry and Remote Sensing (ISPRS), for which PGRSC is the regional representative, regional and European research institutes and the regional network ART-GeoDEV-NC, and public and private users.

39 presenters from 16 different countries around the world animated these two days conference. Even if the Pacific countries were well represented (Fiji, Guam, Tonga, Samoa, Kiribati, New Caledonia, French Polynesia, Salomon Island), the increasing number of well known experts and scientists from USA, Europe (Belgium, France, Germany), India, UK, New Zealand and Australia participating to the event indicates the attractivity and the high level of this event.

A virtual conference is a challenge and is a first for PGRSC and the community was there and shared the success of the event on social networks. The next conference is set for November 22-26, 2021 in Port-Vila, Vanuatu for THE Pacific Island Annual Earth Observation Conference!

Dr. Masasso Giulio Paunga Acting Vice-Chancellor and President USP opened the conference

Conference proceedings:

http://www.picgisrs.org/2021-pacific-islands-gis-rs-user-intermediate-conference-full-programme/

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The inventory section of Fiji's Forestry Department following the presentations

6. Deimos Imaging

Lucia Garcia Lopez

Deimos Imaging (DMI) is a geo-information company that provides exclusive access to Earth Observation imagery through a unique virtual constellation of more than 30 satellites. DMI is also launching UrtheDailyTM, the satellite constellation designed to capture scientific-grade imagery of the Earth every day. Its wide range of products, services and customizable solutions are based on this unique alliance. DMI's extensive portfolio provides significant benefits to its customers worldwide by providing reliable solutions and by enabling effective decision-making in a great variety of fields.

Deimos Imaging owns and operates 2 satellites:

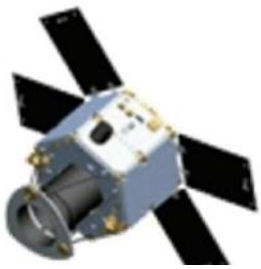
Deimos-1

Captures 22m-resolution imagery with a very wide 650 km swath. Specifically designed to cover large areas very frequently, it's ideally suited for applications such as precision agriculture and forestry monitoring.

Launch date: July 29, 2009 * Avg. revisit time: 3 days * Agility: Fixed, Nadir- oriented Spectral bands: – Green 520-600 nm – Red 630-690 nm – NIR 770-900 nm * A synthetic Blue band can be generated to produce natural color imagery.

Deimos-2

A very-high-resolution, agile and cost-effective satellite that provides 75cm/pixel pan-sharpened imagery with a 12km swath. *Launch Date: June 19, 2014 *Lifespan: 10 years *Avg. Revisit Time: 2 days *Agility: ±45° off nadir Spectral Bands: – PAN 560-900nm – Blue 466-525nm – Green 532- 599nm – Red 640-697nm – NIR 770-892 nm.



From 2006, Deimos Imaging has been delivering EO products and services to customers such as European Space Agency (ESA), European Maritime Safety Agency (EMSA), U.S. Department of Agriculture (USDA), Brazilian Airforce (BACE), GEOSYS and many others.

DMI has developed a great experience in different projects on Remote Sensing in many sectors of the industry: Agriculture, Maritime, Land Administration & Mapping, Defense & Security, Civil Protection, Oil & Gas, Forestry & Environment, Emergency & Disaster Management. Here are some of the most relevant:

European Maritime Safety Agency (EMSA): Deimos-1 and Deimos-2 are part of the Copernicus Maritime Surveillance (CMS) service managed by EMSA. Deimos Imaging provided updated areas to EMSA up to 4 hours before acquisition (maximum cut-off time). DMI was able to adapt its processing chain and internal workflows for all high-level requirements set by EMSA and delivered data in under 30 minutes.

USDA crop monitoring:

Since 2011, the U.S. Department of Agriculture (USDA) has used Deimos-1 as its main satellite imagery source to monitor more than 100 types of crops in the U.S. daily, and to produce its annual 30- m Cropland Data Layers which classifies all types of crops in the country.

Coverage of the disputed South China Sea: The ''Big 3'' islands; Subi, Mischief and Fiery Cross Reef have undergone major construction of military and dual-use infrastructures. Deimos imaging managed integrated operations for tipping & cueing between its two satellites. Deimos-2 imagery showed the ongoing construction of new facilities while Deimos-1 illustrated change detection of wide- areas.

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7. Exploring Open Source Alternatives for Satellite Data Pre- Processing

Litia Gaunavou, Lanieta Rokotuiwakaya.

The South Pacific region is well known for its geographic dis-advantage with land masses smaller in areas than the vast ocean space that encompasses it. Furthermore, the landscapes itself has various relief which can be described as the change in land structure of an areas of the Earth's surface. This varying relief is a major contributor to fluctuating climate over an area and leads to a micro-climate system (Forstreuter, 2012). The Volcanic islands in the Pacific region experience this situation when the sun can be illuminating over one side of the mountain however on the other side is cloudy. This creates distortion when optical sensors capture imagery over these areas. Therefore, it is important that such images go through pre-processing to ensure that the distortions and other flaws associated not only with the surrounding atmospheric conditions but with the optical sensors are corrected before further analysis to extract valued added data.

Over the years, the GIS & Remote sensing unit of SPC has developed pre-processing methods suitable for the Pacific region and has been the central team to pre-process imagery before distribution to its member countries. This was due in part to software cost. This paper aims to describe utilizing the Orfeo (OTB) toolbox as an alternative to proprietary software that developing island states can use to build capacity in this area.

In 2005 the National Centre for Space Studies (CNES), the French Space Agency developed OTB which is a library of spatial analysis tools to assist users with analysis and visualizing the sub-metre Pleaides satellite data. OTB has since evolved to include multiple sensors as part of its remote sensing algorithms.

OTB can be accessed through visualization tools like Monteverdi, an integrated software for manipulating imagery. It can also be implemented as a plugin into QGIS with its own set of application framework (Tinel, 2012). Figures 1 and 2 shows the graphical interface of Monteverdi and as part of QGIS respectively.

According to (OTB CookBook, 2011) the most straightforward way to extract the OTB library is via programming platforms such as Python and C++. Detailed documentation is available from download to installation right down to the processing and can be accessed from the OTB Cookbook.

OTB can perform pre-processing analysis such as ortho-rectification, radiometric calibration, pan sharpening as well as other basic rescaling, resampling and extraction. The main advantage of OTB is that like the proprietary software's; it can also perform high end remote sensing process like classification, segmentation and change detection. The success of OTB can be attributed to the dedicated group of open source community that from inception aimed at providing a no cost software for remote sensing analysis that users are able to operate to create meaningful outputs that will aid the community in sustainable solutions.

Figure 1: Monteverdi Interface showing the pan-sharpening module Conference

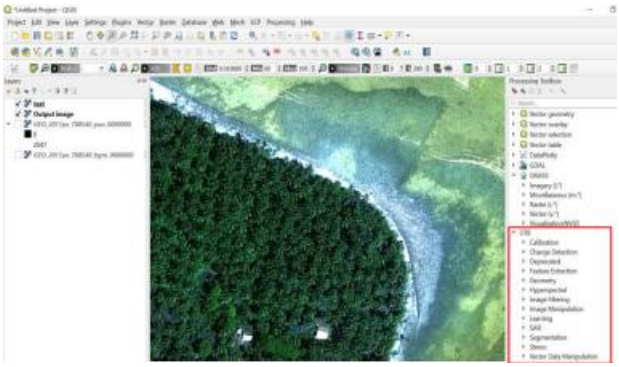

Figure 2: OTB as an application framework within QGIS highlighted in red box

For more Information

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