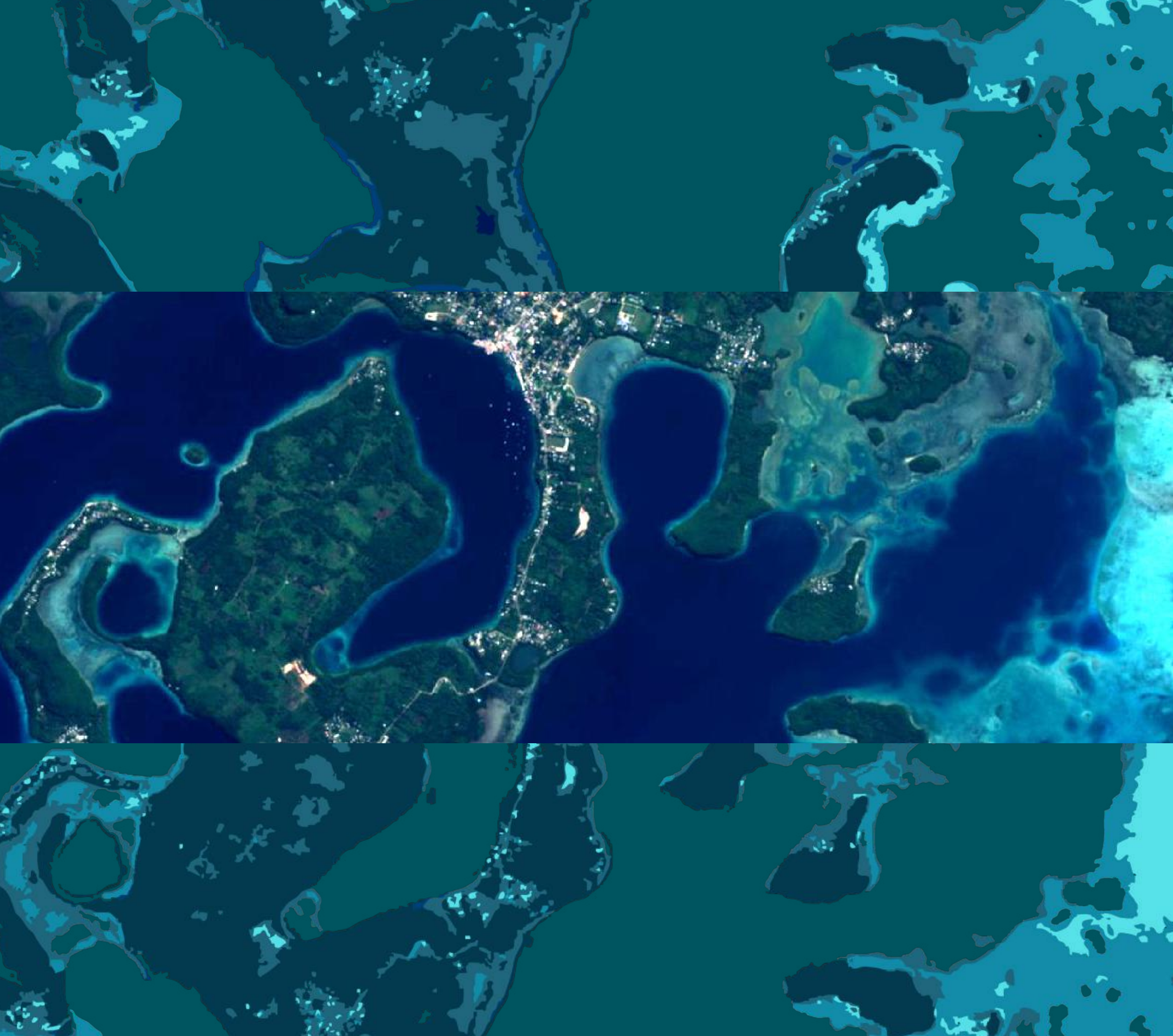

PACIFIC ISLANDS GIS & RS NEWSLETTER

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Pacific GIS and Remote Sensing Council

PACIFIC ISLANDS GIS&RS NEWSLETTER

Dear Reader,

The Pacific GIS and Remote Sensing Newsletter publishes articles related to GIS and remote sensing applications in Pacific Island Countries. The newsletter also provides updates on applicable data and technology for the Pacific.

The Pacific Community (SPC) and the Pacific GIS and Remote Sensing Council (PGRSC) have signed a Memorandum of Understanding (MOU) to coordinate outreach, training, and regional networking in support of strengthening geospatial and earth observation work for Pacific communities, thereby better informing decision-makers and the public about the importance and great potential of these technologies.

The MOU establishes a practical framework for collaboration, including joint promotion across platforms, audience-friendly materials that explain how satellite and geospatial data support everyday decisions, and coordinated workshops and webinars. It also strengthens country-level engagement through PGRSC's national focal points network.

Bradley Eichelberger, PGRSC Chair, stated, "We are both honoured and excited to collaborate with the Pacific Community on ways to expand geospatial and earth observation capacity and knowledge sharing across the Pacific Islands countries. Geospatial and remote sensing applications are essential services that provide science-based solutions to solve some of the key issues in the region, and the outcomes of this partnership will build strong, resilient Pacific Islander communities."

For contributions and inquiries:

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Any member of the team can be contacted to discuss and edit new articles.
The newsletter can be downloaded from the PGRSC website https://pgrsc.org/newsletter/.

CONTENT

Image Credit © ICA

Why Maps Matter:

Cartography and Its Relevance for the Pacific Region

by Georg Gartner & Amy Griffin

In an age where we can zoom in on almost any place in the world using our smartphones, it's easy to assume that traditional maps—or the people who make them—are becoming irrelevant. But that couldn't be further from the truth. Especially for the Pacific Region—spread across thousands of islands, ocean routes, and vulnerable coastlines—maps remain incredibly important. They don't just help us get around; they help us understand and manage our place in the world.

So, let's explore what maps really are, why they still matter, and how connecting with the global mapmaking community through the International Cartographic Association (ICA) could be a powerful move for Pacific Island nations.

A Satellite Image Is Not a Map

At first glance, a screen dump from Google Earth looks like a map—it shows coastlines, roads, villages, maybe even your house. But it's really just a satellite photo, full of raw visual data. Some details may be hard to see, for example, if they fall within a shadow. A map, on the other hand, is a carefully designed tool created to communicate specific information. It's made with purpose, whether to show safe routes across the sea, identify climate risk zones, or preserve traditional land knowledge. Using a map to tell a story can help decision makers understand the issues and see what the potential solutions might be.

Cartographers—mapmakers—don't just reproduce what's visible from space. They *select*, *simplify*, and *emphasize* certain information so the map can tell a clear story. This is especially important in the Pacific, where islands are often underrepresented or missing altogether on global maps. A good map ensures visibility, accuracy, and meaning for local communities.

ICA

ACI

Image Credit © OpenStreetMap & ESRI

What Makes a Map Useful?

Maps are not just about where things are. They include features that help us understand spatial relationships and act on that knowledge:

- Grid and Coordinates: Helps locate exact positions—crucial when planning disaster response or navigating open waters.
- Scale: Tells you the relationship between map distance and distance in the world. Without a scale, a tiny atoll could look the same size as a mountain range.
- Symbols and Color: Represent features like reefs, fishing zones, cyclone shelters, or sacred sites. These make complex information understandable at a glance.
- Legend (Key): Explains what the symbols mean.
- Orientation (North Arrow): Keeps you oriented in space—especially helpful for maritime travel.
- Projection: Every flat map has some distortion. Choosing the right projection ensures island regions aren't minimized or misplaced—an ongoing issue for Pacific nations on global maps.

Each of these elements adds value, turning geographic data into practical knowledge. And with the effects of climate change, rising seas, and increasing development pressure, this kind of knowledge is more important than ever.

The Many Roles of Maps

In the Pacific region, maps serve a wide range of purposes that touch nearly every aspect of life:

1. Maritime Navigation: Traditional voyaging, fishing, and modern shipping all rely on accurate sea charts and route planning tools.
2. Disaster Preparedness: Maps help identify cyclone-prone areas, tsunami risk zones, and evacuation routes—saving lives when time is critical.
3. Climate Change and Environmental Management: Tracking coastal erosion, rising sea levels, and vulnerable ecosystems all depends on consistent spatial data.
4. Cultural Mapping: Preserving language areas, sacred spaces, customary land boundaries, and oral histories can be supported by community-led mapping projects.
5. Urban and Rural Planning: Whether it's designing new infrastructure or protecting traditional land tenure systems, maps help ensure decisions are fair and based on real data.
6. Tourism and Economic Development: Tourism operators, government planners, and small businesses use maps to promote heritage sites, eco-tourism trails, and local attractions.

Why collaborate with the International Cartographic Association (ICA)?

The International Cartographic Association (ICA) is a global network of people who care about maps—from scientists and educators to government planners and Indigenous mapping experts. For Pacific Island nations, joining the ICA can open doors to resources, collaboration, and influence that might otherwise be out of reach.

Here's how ICA membership could benefit the region:

- Capacity Building: ICA supports training and education in cartography, including digital mapping, GIS, and remote sensing—skills that are increasingly needed in Pacific communities.
- Representation: By participating in ICA, Pacific nations can ensure that their perspectives, challenges, and cultural knowledge are included in global conversations about mapping and data.
- Access to Resources: Members gain access to the latest research, tools, and technologies, as well as global map competitions, workshops, and educational materials.
- Partnerships and Support: Through ICA, local cartographers, government departments, and community organizations can connect with international experts and institutions working on similar issues—whether that's disaster resilience, Indigenous mapping, or environmental conservation.
- Influence on Standards: Membership allows Pacific Island countries to have a voice in shaping international standards for map design, data collection, and digital tools—important in ensuring that island nations aren't marginalized by one-size-fits-all mapping practices.

Maps Matter

For Pacific Islanders, maps are not abstract tools—they're directly tied to the way of life, the environment, and the future. From traditional sea navigation to climate resilience planning, mapping is essential to how we understand and protect Pacific islands.

Even in the digital age, we need more than just satellite imagery. We need maps that reflect our realities, priorities, and stories. That's why the field of cartography matters—and why building skills, partnerships, and representation through organizations like the International Cartographic Association is a valuable opportunity for the region.

From left to right: Dariusz Dukaczewski, Amy Griffin, Tim Trainor, Serena Coetzee, Thomas Schulz, Haosheng Huang, Georg Gartner, Alex Kent, Dušan Petrovič, Jiping Liu
Image Credit © ICA

Contributed by Georg Gartner, Vienna, Austria, and Amy Griffin, Melbourne, Australia
President and Vice-President,
[International Cartographic Association]


Image Credit © Digital Earth Pacific

Mapping Blue Carbon Ecosystems for a Sustainable Pacific

by Raphael Linzatti

The Management and Conservation of Blue Carbon Ecosystems **MACBLUE** project is a regional initiative working to support Fiji, Vanuatu, Solomon Islands, and Papua New Guinea in the protection, sustainable management, and restoration of blue carbon ecosystems—namely mangroves and seagrasses. These ecosystems are vital for climate change mitigation, coastal resilience, biodiversity, and the well-being of local communities.


Image Credit © GIZ

Mangrove stand in Fiji during high tide. Mangroves protect shorelines from erosion and act as nurseries for many coastal species.

Blue carbon ecosystems are particularly important in the Pacific, where coastal communities rely on them for **food security, traditional practices, and livelihoods**. These ecosystems also store large amounts of carbon and play a crucial role in meeting **national and global climate targets**. To map and monitor these ecosystems, the **GIZ Pacific** partnered with the **Pacific Community (SPC)** to leverage **Digital Earth Pacific**, an innovative earth observation and **machine learning platform** designed to make satellite data accessible and actionable for Pacific Island nations. Digital Earth Pacific allows users to process and analyse decades of satellite imagery to generate up-to-date land and coastal ecosystem maps.

Using this platform, **mangrove and seagrass extent maps** are being generated through **supervised classification models**, trained with field-verified data collected across priority coastal sites. This work was made possible through collaboration with national ministries of **environment, forestry, and fisheries** in the four partner countries, academic institutions, and support from the **Secretariat of the Pacific Regional Environment**

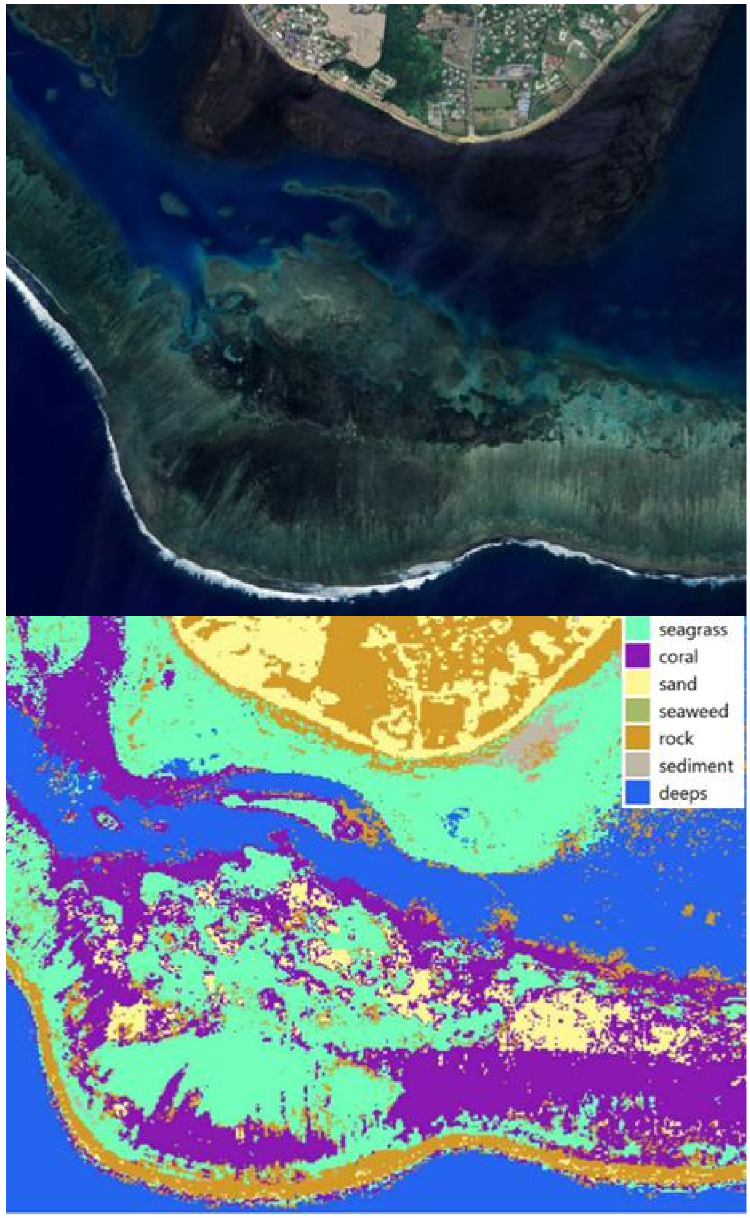
Programme (SPREP), especially collecting field data.

The resulting extent maps will help **quantify ecosystem services** such as carbon storage, coastal protection, and fisheries support. Importantly, they will also capture the **cultural and spiritual values** attached to these ecosystems by Indigenous and local communities contributing to more inclusive and locally grounded management plans.

To date, **mangrove extent maps covering the years 2017 to 2024** have been developed for all four partner countries. These datasets will inform **coastal restoration efforts, blue carbon accounting, and policy decisions**. The first release of **seagrass extent maps is planned for late August 2025** and will provide the first regional baseline for these understudied habitats. Through the

Ground-truthing surveys were critical for training the classification models used in the mapping process.

integration of **satellite technology, field science, and traditional knowledge**, the MACBLUE project is enabling Pacific countries to take informed action to **protect their blue carbon ecosystems**—ensuring long-term ecological and cultural resilience in the face of climate change.



An example of a benthic classification map generated via Digital Earth Pacific. Seagrass ecosystems are vital for fisheries, carbon storage, and traditional knowledge systems. Image Credit © GIZ

About the MACBLUE project

The Management and Conservation of Blue Carbon Ecosystems (MACBLUE) project is jointly implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, the Secretariat of the Pacific Regional Environment Programme SPREP, the Pacific Community SPC in close cooperation with their four partner governments Fiji, Papua New Guinea, Vanuatu and Solomon Islands. The project is funded by the German Federal Ministry for Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) through its International Climate Initiative (IKI).

Mangrove extent map (2017–2024) for Fiji. Sample output from Digital Earth Pacific showing mangrove distribution across a key coastal zone.

Learn More:

🌐 [MACBLUE Project – Strengthening Blue Carbon Management in the Pacific]()
The overall objective of the MACBLUE project is to preserve both biodiversity and ecosystem services of important coastal ecosystems as a key contribution to food and income security for coastal populations in Pacific Island Countries.

🌐 [Digital Earth Pacific – Satellite Intelligence for the Pacific]()
Digital Earth Pacific provides decision-makers with the information needed to make sound decisions addressing the Pacific's challenges, most notably climate change, food security and disaster.

MACBLUE
Management and Conservation of Blue Carbon Ecosystems

Digital Earth
PACIFIC

Image Credit © Montgomery Group Asia

Geo Connect Asia 2025: Advancing GIS and Remote Sensing in the Pacific

by Salote Viti & Lanieta Rokotuiwakaya

The 5th Annual Geo Connect Asia Conference, held on April 9-10, 2025, in Singapore, marked a milestone for the geospatial and remote sensing community in Asia. With over 100 speakers, seven interchangeable conferences, and four overlapping exhibitions, the event provided a dynamic platform for professionals to explore innovations, share knowledge, and foster collaboration.

Key Highlights for the Pacific Region

Representing the Pacific GIS & Remote Sensing Council (PGRSC), Salote Viti and Lanieta Rokotuiwakaya participated in the conference, emphasizing the importance of Earth Observation (EO) technologies for sustainable infrastructure development in the Pacific. The PGRSC highlighted the region's unique challenges, including geographic dispersion, climate vulnerability, and limited land resources, and underscored the role of EO technologies in addressing these issues.

Harnessing EO Technologies for Sustainable Development

Image Credit © Salote Viti & Lanieta Rokotuiwakaya

EO technologies such as Synthetic Aperture Radar (SAR), hyperspectral imaging, and UAV drone imagery were showcased as transformative tools for the Pacific. These technologies enable:

- **Monitoring Land Use and Urban Growth:** Accurate mapping ensures sustainable expansion while protecting sensitive ecosystems.
- **Disaster Risk Reduction:** Real-time data supports effective disaster

Image Credit © Salote Viti & Lanieta Rokotuiwakaya

- preparedness and response, particularly for climate risks like cyclones and sea-level rise.
- **Sustainable Infrastructure Planning:** Remote sensing informs decisions on transportation networks, renewable energy placements, and water resource management.

Fiji's Strategic Spatial Master Plan, developed through collaboration between the Singapore Cooperation Enterprise and the Fijian Government, was highlighted as a successful example of using geospatial data for urban planning and economic growth.

Strengthening Regional Collaboration
The conference emphasized the need for regional cooperation to maximize the benefits of GIS and remote sensing.

A strong regional GIS/RS council can play a pivotal role in:

- **Capacity Building:** Training programs and technical exchanges to equip Pacific nations with EO expertise.
- **Policy Advocacy:** Promoting open-access geospatial data for equitable use across the region.
- **Innovation and Partnerships:** Encouraging collaboration between governments, academia, and private-sector entities to develop tailored solutions.

Image Credit © Salote Viti & Lanieta Rokotuiwakaya

APAC Earth Observation Forum
The inaugural Asia-Pacific (APAC) Earth Observation Forum, held during the conference, brought together regional leaders to discuss collaboration in EO technologies. Salote Viti chaired a panel on "Strengthening Collaboration in Earth Observation," where panelists deliberated on harmonizing policies, addressing data sovereignty, and driving EO initiatives for climate resilience and disaster management.

Image Credit © Montgomery Group Asia

Insights for the Pacific

The conference provided valuable takeaways for the Pacific GIS & Remote Sensing Council:

1. **Enhancing Regional Collaboration:** Cross-border partnerships and regional organizations are key to advancing geospatial initiatives.
2. **Public-Private Partnerships:** Successful collaborations between governments and private entities can accelerate technological adoption in the Pacific.
3. **Embracing AI and Robotics:** Integrating artificial intelligence into EO technologies offers opportunities for improved environmental monitoring and disaster response.

Image Credit © Montgomery Group Asia

Conclusion

Geo Connect Asia 2025 was a resounding success, offering a wealth of knowledge and networking opportunities. For the Pacific region, the event underscored the critical role of GIS and remote sensing in addressing infrastructure challenges, climate risks, and sustainable development. By leveraging EO technologies and fostering regional collaboration, the Pacific can build resilient communities and ensure a sustainable future.

Geo Connect 2026

Location based knowledge and the availability of reliable data are crucial components in effective decision-making. Geo Connect Asia is the annual regional meeting place to bring practical and proven solutions to the market, combining four overlapping exhibitions with a series of conferences to exchange inspiring ideas and share cross industry experiences. Register your interest at **geoconnectasia.com**.

Space-Based Observations of Our Pacific Islands

by Andiswa Mlisa

Empowering regional data use through Digital Earth Pacific

Seeing Our Islands from Space

Across the Pacific, information is power — but access to consistent, reliable Earth observation data has long been limited by connectivity, cost, and technical barriers. Digital Earth Pacific (DE Pacific) is transforming this landscape.

Developed under the Pacific Community (SPC), DE Pacific is an operational Earth and ocean observation platform that turns decades of open satellite imagery (Landsat series and Sentinel-2) into free and open decision-ready geospatial datasets. It further provides tools and services that enable Pacific geospatial experts to generate their own innovative local solutions through the DE Analytical Hub. The goal: *to make space-based information accessible and usable by every Pacific nation.*

Turning Open Satellite Data into Action

Digital Earth Pacific goes beyond data delivery — it builds decision-ready products that help governments, scientists, and practitioners act on change they can see.

From monitoring coastal erosion and tracking mangrove loss to mapping floods, droughts, and deforestation, these datasets empower evidence-based planning across the environment, climate change, agriculture, infrastructure, and disaster management.

Each product is designed to align with national, regional, and global commitments, including the 2050 Strategy for the Blue Pacific Continent, the Paris Agreement, the Sustainable Development Goals (SDGs), and the Sendai Framework on Disaster Risk Reduction, to mention just a few.

Featured Decision-Ready Products

PRODUCT	PURPOSE AND USE
Pacific Coastline Change (Beta)	20+ years of shoreline movement data for erosion and adaptation planning.
Pacific Mangrove Change Detection (Beta)	Monitors mangrove canopy density for ecosystem accounting and climate loss & damage assessments.
Water Observations from Space (WOfS) (Beta)	Tracks flood and drought dynamics across 10+ years of surface water data.
GeoMAD (Alpha)	Cloud-free annual composites for consistent vegetation, soil, and moisture monitoring.
Satellite-Derived Bathymetry (Alpha)	Shallow-water mapping up to 30 m depth — vital for coastal and marine resource management.
Pacific Intertidal Model (Alpha)	Maps tidal exposure zones, improving understanding of coastal morphology and processes.
Fractional Cover (Alpha)	Weekly mapping of green and non-green vegetation for agriculture and land use.
Vegetation Height & Deforestation (Alpha)	LiDAR-trained models for forest height, biomass, and habitat change.
Benthic Habitat Mapping (Alpha)	Tracks 10 marine habitat classes, including seagrass, to support ecosystem management.

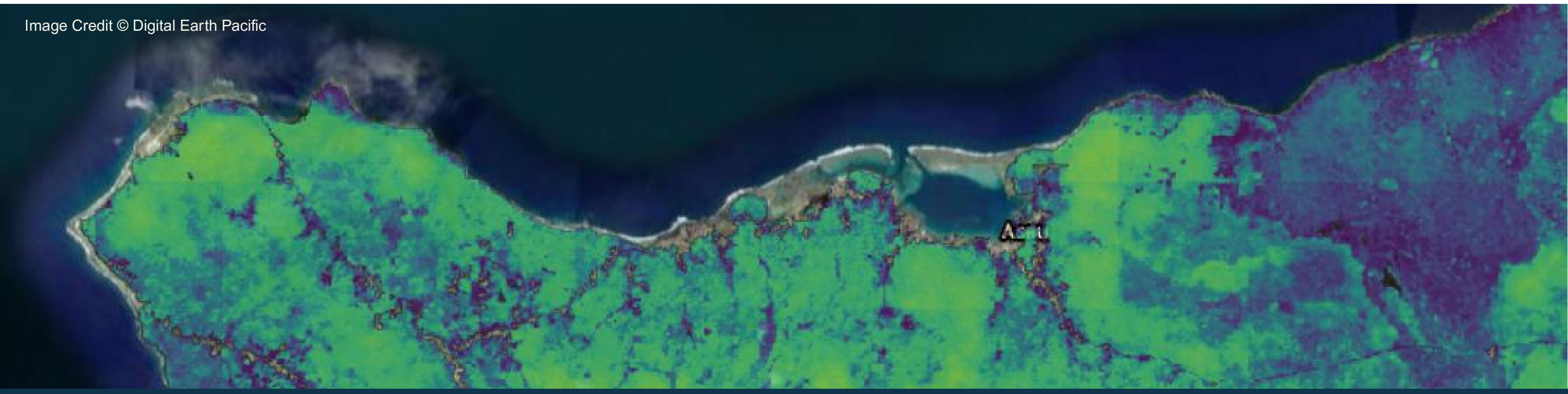
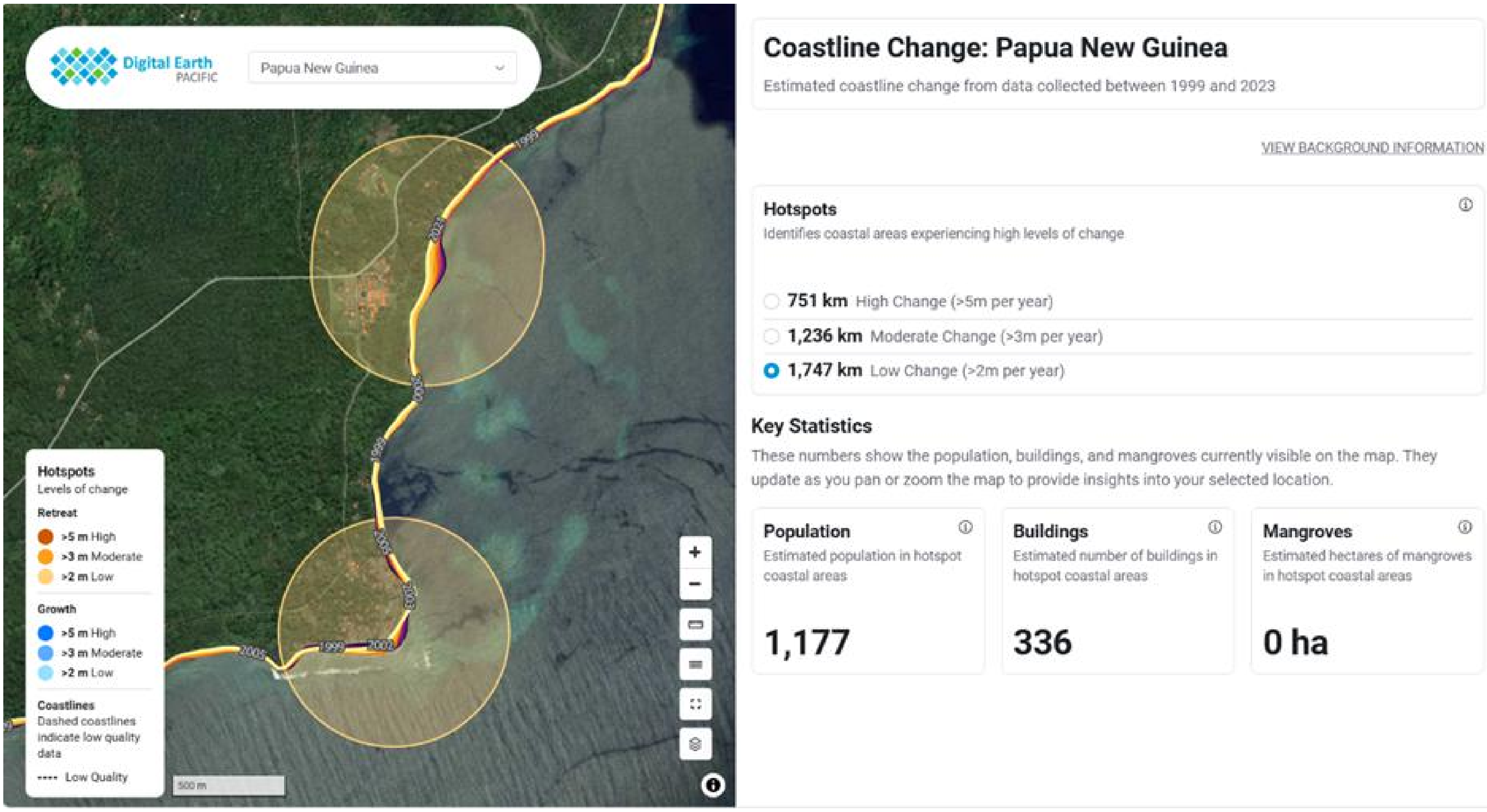


Image Credit © Digital Earth Pacific



The DE Pacific Coastlines Dashboard highlights areas where coastlines are changing —retreating or growing by more than two metres per year—and identifies hotspots with high change exceeding five metres per year. Users can zoom into specific areas to observe long-term trends and combine these insights with local knowledge to better understand vulnerability and resilience opportunities.

“When we looked at the maps showing the seafloor and coastal areas, we were able to recognize many of the fishing grounds and reef channels that our elders have spoken about for generations. The shallow areas shown in the SDB maps matched the traditional fishing spots we call ‘iqoliqoli ni qase’, where certain fish are known to gather during low tide.”

- Mrs Kini, Votua Community Women Lead, 2025

Built for the Pacific, by the Pacific

A hallmark of DE Pacific is that it is co-created with the communities it serves. Guided by ten core principles — including user-centric design, public-good access, and interoperability — DE Pacific ensures Pacific voices shape the data services they rely on.

Starting with comprehensive user requirements gathering through national workshops to ongoing co-designed capacity building initiatives that have seen over 200 Pacific islanders trained over 12 workshops within the past 2 years alone.

"...You can't protect something if you don't first understand it... From the projects I've seen in this workshop, I see that participants are using these technical tools to establish a baseline with which to measure changes and to provide information to decision makers... "

- David Paul, Minister of Finance, RMI, 2024

DE Pacific Mangrove Product showing impact of Cyclone Yasa on Fiji mangroves, in 2020 pre-cyclone (top image) mangrove density is high (dark green colour), in 2021 following the cyclone density is very low, almost undetectable the mangroves (middle image) and in 2022 mangrove density is improving, a sign of recovery. Image Credit © Sentinel-2 2024 Imagery

Collaborating for Impact

The initiative is overseen by a regional steering committee comprising countries (Australia, Cook Islands, Fiji, PNG, RMI, Solomon Islands, Tonga, Tuvalu, and Vanuatu), regional organizations (SPREP, USP, SPC, and PGSC), and international organizations (Digital Earth Africa, CEOS, GEO, NOAA, and WFP).

Through these partnerships,
DE Pacific is:

- Validating and refining products for local use
- Building capacity for Earth observation and GIS applications
- Developing new tools and models tailored for Pacific needs
- Integrating geospatial data into policy, monitoring, and reporting systems

We invite you to collaborate with us in any and all of the above areas.

Strengthening Our Digital Blue Continent

As it evolves, Digital Earth Pacific will continue expanding its observation assets, decision-ready products, improving access through cloud-native services, and fostering the growth of local geospatial industries.
By combining space technology, Pacific expertise, and open data, DE Pacific is ensuring that every island nation can see itself clearly — and act with confidence.

For more information:

Website: www.digitalearthpacific.org
Email: askdepacific@spc.int

Image Credit © Naitasiri Vou

Inventory of Common Bamboo in Naitasiri, Fiji

by Wolf Forstreuter, Alivereti Naikatini, & Vili Tupua

Already in the early 1990s, the Fiji Bamboo Association showed interest in mapping bamboo resources alongside Fiji's National Forest Inventory. At that time, internationally recognised species such as *Bambusa vulgaris* (common bamboo) were introduced, quickly spreading along Fiji's river systems. The idea behind forming an association and introducing this species was its fast regeneration, its many uses, and the fact that it could be harvested easily without heavy machinery. Bamboo transport was also already familiar in Fiji as a traditional means of transport on *bilibilis* (bamboo rafts), which also works without a carbon footprint.

The Fiji Bamboo Association (FBA), a public–private partnership, was re-established in 2019 to promote, support, and protect the bamboo industry in Fiji. In 2020, Fiji became a member of the International Bamboo and Rattan Organisation (INBAR), represented by the Ministry of Forestry.

The Global Green Growth Institute (GGGI) launched the project "Fiji Bamboo to Adapt and Mitigate Climate Change." A key part of the project was a pilot inventory to estimate the availability and characteristics of *Bambusa vulgaris* in Fiji's Naitasiri Province.

Nature of *Bambusa vulgaris*

In Naitasiri, common bamboo can exceed 30 metres in culm length. However, the culms are not straight; instead, they bend outward from the patch or clump. The culms first grow straight, with a yellowish colour and almost no leaves, reaching nearly their full height. Only then do they begin to produce branches and leaves, which causes them to bend more and more, especially after each rainfall.

A single bamboo clump. The stocking area is significantly smaller than the canopy area.

The clumps form a closed canopy with little vegetation between the stocking area.

Another characteristic of *Bambusa vulgaris* is its growth in dense patches (clumps), with almost no vegetation in the spaces between, apparently due to the very closed canopy. The crown area of a bamboo clump is about 12 times larger than its stocking area. This pattern is different from that of the native Fijian bamboo *bitu dina* (*Schizostachyum glaucifolium*).

Nearly all common bamboo in Naitasiri grows along the bigger rivers. Bamboo cover away from the rivers is extremely seldom.

Mapping the Common Bamboo

The characteristics of common bamboo have both positive and negative effects on mapping using space-borne remote sensing data. Drone imagery is not a feasible option when attempting to map an entire province.

The positive characteristic is the extremely bending culms, which create a distinctive texture that allows the bamboo to be distinguished from other vegetation and even from other bamboo species. However, accurate mapping requires: (i) very high-resolution (VHR) imagery with sub-metre spatial resolution, since free Landsat or Sentinel-2 data are not suitable; (ii) object-based analysis software such as eCognition, or AI-based cloud platforms; or

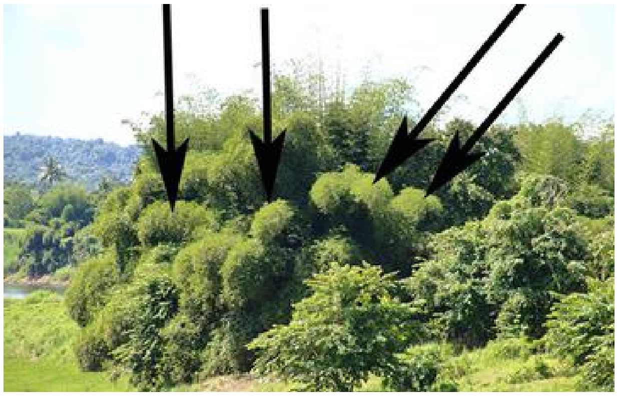


Figure 01: The bamboo culms bend away from the centre.

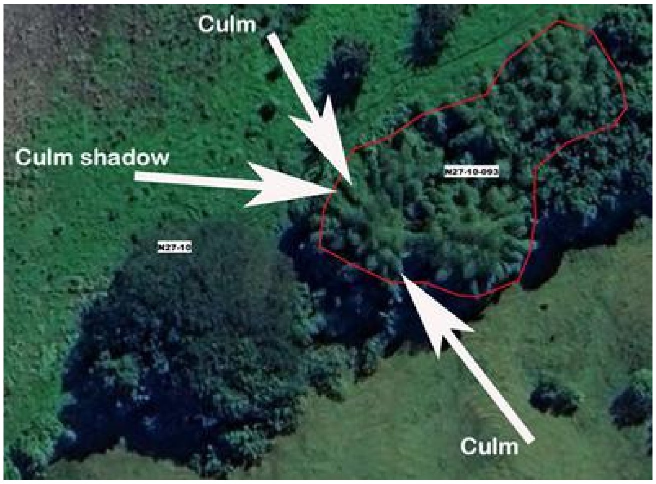


Figure 02: The culms bending away from the centre create a typical texture different from other bamboo species and other vegetation.

(iii) a team performing visual image interpretation, familiar with both the data and the appearance of bamboo on the ground. The common bamboo may also exhibit a distinct radiometric signature compared with other vegetation and bamboo species, though this has not been investigated.

The project planning did not account for funding for space-borne imagery or for partially outsourced AI-based image analysis. Very high-resolution (VHR) imagery over ten years old was available, but the necessary atmospheric correction and cloud patching would have made semi-automatic, classical maximum likelihood image analysis extremely time-consuming. As a workaround, the mapping was carried out through visual interpretation within the QGIS environment. QGIS allows access to and use of Google Earth imagery, although the exact sensor and image capture dates are unknown.

Experienced interpreters from the inventory section of FRAC, Fiji's Forestry Department, mapped the bamboo areas in a reasonable time as a joint effort of four operators.

The mapping was carried out separately for every map sheet tile of Fiji's topographic map[1].

Accessing Stocking and Physical Bamboo Characteristics

Mapping bamboo using space-borne imagery provides the area of the canopy. However, the main goal of the inventory is to determine the stocking, specifically the number of culms per hectare. In addition, the inventory must capture physical bamboo characteristics such as: (i) culm height, (ii) culm diameter, and (iii) wall thickness.

To estimate stocking, it is necessary to know the number of culms within a bamboo patch. At the same time, the number of patches or clumps per hectare must be calculated, because the crown-to-stock relationship applies only to individual patches. Since the crowns of different patches strongly overlap, estimating the number of clumps per hectare requires a separate approach.

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[1] *Fiji's topographic map covers 40 x 30 km and is divided into 12 map sheet tiles.*

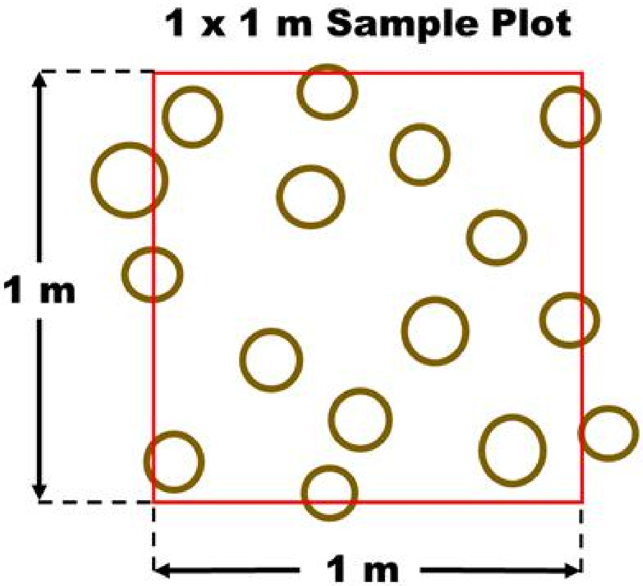


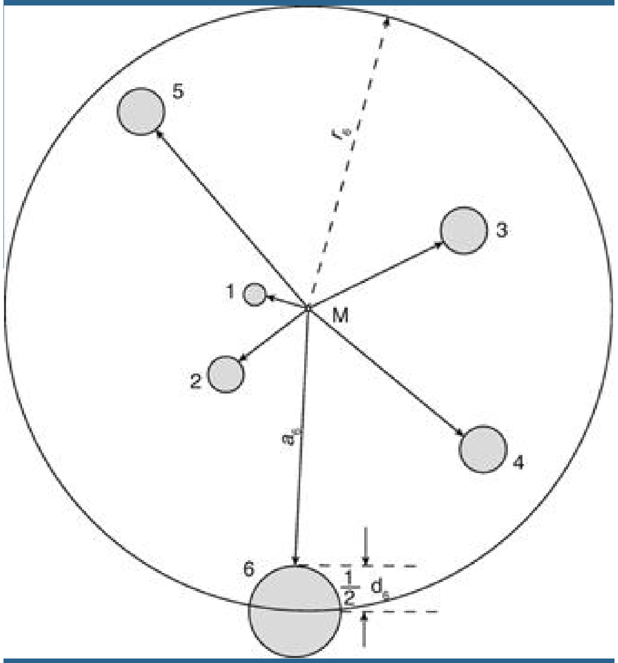
Figure 03: A theoretical sample of 1x1 m size. The sample boundary would cross several culms, and the calculation of culms per m^2 would be complicated.

Density of Bamboo Culms within a Bamboo Clump

Counting the culms of a single bamboo patch or clump is just as challenging as counting trees in a forest. Foresters typically use sample plots and extrapolate the results to the entire area. The same approach was applied to bamboo clumps: four systematically distributed samples were established for each clump, taking into account that culm density is higher in the centre than at the periphery. This allowed for the calculation of the number of culms per square metre.

Most forest inventories in the Pacific use fixed sample sizes. This approach is difficult in bamboo patches, as many culms cross the boundaries of a fixed sample (see Fig. 03). For this reason, a distance sampling method was chosen, with two main options: (i) the Bitterlich angle count sampling and (ii) Prodan's 6-Tree sampling. Since angle count sampling is not feasible for bamboo, Prodan's method was implemented[2]. This method has proven successful for relatively homogeneous stocking:

Figure 04: For the six culm sample method the diameter and the distance of the culms to the sample centre (M) are recorded for the six culms closest to the centre.



while culm density is higher in the centre of a clump, the overall stocking of a clump is fairly uniform.

The team measures the distance from the sample centre to each culm, as well as the diameter of the culms. Measuring the distance helps identify the culm furthest from the sample centre. The distance to the sixth culm, plus half its diameter, defines the area of the sample (see Fig. 04).

This allows the number of culms to be related to the sample area. This is the basic principle of Prodan's 6-Tree sampling. For statistical reasons, 5.5 culms are counted instead of six. To estimate the density of culms per square metre within a clump, the areas of all four samples are combined and related to 22 culms. This setup ensures that two samples are taken from the central area of the clump and two from the more outer periphery.

Number of Bamboo Clumps per Hectare

As mentioned above, although precise figures were established for the relationship between culm canopy area and culm stocking, incorrect estimates would result if the total mapped bamboo area were simply divided by the average clump canopy area. Because clump crowns overlap, alternative methods are required. Once again, distance measurements were applied: for each clump, the distances to the three nearest neighbouring clumps were used to calculate the average distance[3] and, from this, the number of clumps per hectare.

Other Bamboo Characteristics

Some bamboo characteristics cannot be captured with very high-resolution (VHR) space-borne imagery, making field data collection essential, for example, culm diameter, height, and wall thickness. As mentioned, culm diameters were recorded in the six-culm samples. With six diameters per sample, four samples per clump, and 60 plots in total, this resulted in 1,440 diameter measurements systematically distributed, allowing for an accurate calculation of the mean diameter.

For each of the four samples within a clump, the culm closest to the sample centre was selected and its length measured. The diameter was recorded for the first and second 5-metre sections at both ends of the culm. Wall thickness was also measured at both ends, with three measurements taken using a vernier caliper.

Figure 05: Extracting a culm out of a clump

Continuation in Fiji's Forestry Department

The weak points of the inventory were the lack of remote sensing data and the distribution of the plots. However, a database has been established, allowing additional plots to be integrated if required. The same approach applies to bamboo assessments in other provinces. The mapping can be updated continuously as new imagery becomes available, with map sheet tiles providing a sustainable geographical unit for updating and monitoring.

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[2] *Prodan, M. (1968). Punktstichprobe für die Forsteinrichtung. Forst Holzwirt*

[3] *This is a derivation of Prodan's six tree sampling published by Space, J. C., & Turman, D. (1977)*

Pacific GIS and Remote Sensing Council

PACIFIC ISLANDS GIS&RS CONTACT

Have an article you would like to write? Any questions about PGRSC membership?

Contact Us!
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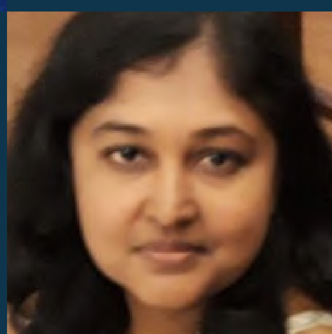

Kasaqa Tora, Secretary

At-Large Members

Wolf Forsteuter

Salote Viti

Maria Kottermair

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