

Digital Earth Pacific: Needs assessment report



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Suva Regional Office, Fiji, 2021

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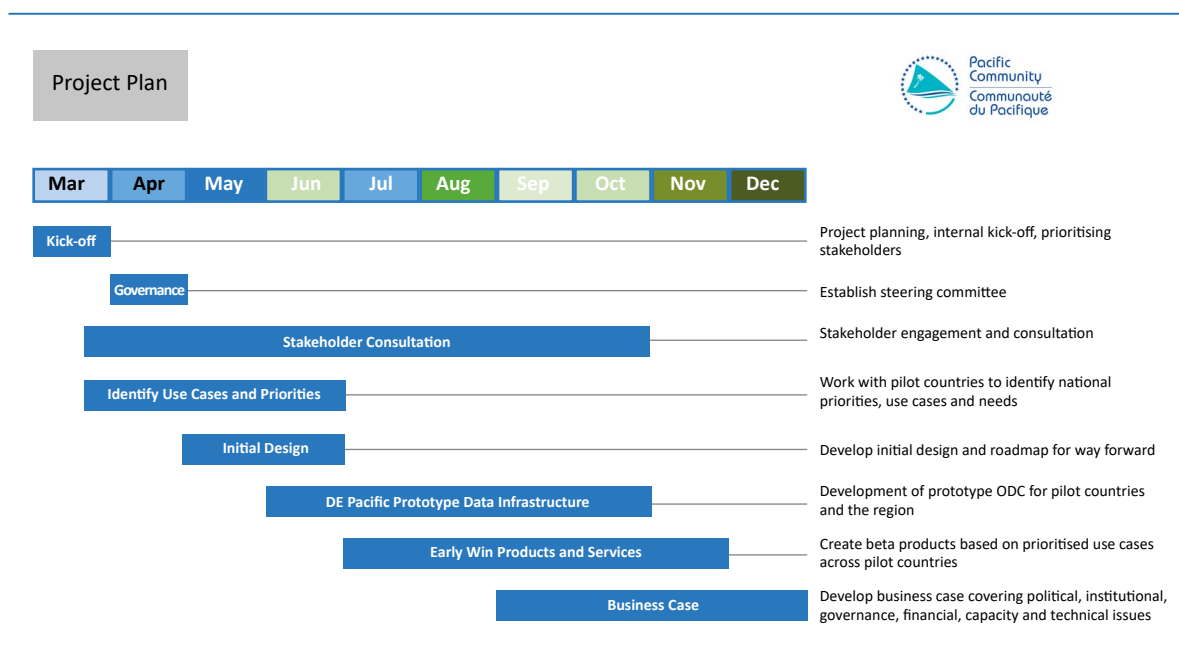
1. Introduction

Globally, the effects of climate change are already being observed through increases in drought, forest fires, sea level rise, flooding and hunger. Given the vulnerability of Pacific Island countries and territories (PICTs) in this respect, the Pacific region faces unique challenges in managing natural resources and biodiversity, securing economies and livelihoods and ensuring sustainable food systems. More disaggregated, real time and scalable data and technology is needed to ensure sound decisions, policies and action.

Thanks to generous funding from the Australian Department of Foreign Affairs and Trade (DFAT) and the US National Oceanic and Atmospheric Administration (NOAA), the Pacific Community (SPC) initiated Phase I of Digital Earth (DE) Pacific: conducting a needs assessment and developing a business case for making free, open and operational satellite data available for the region. Based on previous experiences in Australia and Africa (as well as a number of national implementations around the world), DE Pacific will provide a cloud-based data infrastructure making analysis-ready earth observation data available to users across the region with open algorithms and analytical capabilities allowing SPC, governments, academic and research institutions, civil society and the private sector to create data products and services to address national development priorities and sustainability issues.

The aim of Phase I is to initially consult with countries to better understand their requirements to ensure there is buy-in for a DE Pacific capability and that the solution envisioned is aligned with the existing policy needs of SPC member countries and territories. The following project plan for 2021 (see Figure 1 below) was developed whereby the needs assessment is couched within a broader plan to include governance, identify use cases, develop a prototype, create early win products and develop a business case for DE Pacific that outlines the political, institutional, capacity, technical and financial considerations to launching a sustainable programme.

Figure 1: Project plan, 2021



An Interim Steering Group (ISG) was established in April 2021 inclusive of member countries, international organisations, universities and research institutions. The ISG's mandate is to provide overall strategic guidance to the programme and support the successful implementation of Phase I ([Appendix 4.1](#)). Included in the ISG are three member countries that represent the pilot countries for which the needs assessment was conducted (Republic of the Marshall Islands (RMI), Tonga and Vanuatu) and Fiji¹.

It should be noted that previous needs assessment and scoping exercises have been conducted by several organisations to address how earth observation can be better accessed and used for the Pacific. For reference, these studies include:

- CSIRO 2019. [An Earth Observation Platform to Support Pacific Island Nations Environmental, Climate and Livelihood Needs – Consultation Workshop](#) (accessed 30 September 2021).
- GEO 2019. [Earth Observation Cooperation in the Pacific: Talanoa Outcome Statement](#) (accessed 30 September 2021).
- SPC 2019. [Pacific Earth Observation Coordination Meeting](#) (accessed 30 September 2021).

¹ A fourth workshop was planned for Fiji but was not completed due to the prolonged COVID-19 lockdown in Fiji from April to September 2021.

2. National consultations

With support from the ISG and the pilot countries, a process for national consultations was developed to support the needs assessment in order to:

- bring key institutions across each country together to discuss policy, technical and capacity issues as related to the use of earth observation data for decision-making;
- provide a moment to signal the importance of this initiative;
- identify needs, priorities and potential use cases;
- identify opportunities for alignment;
- identify capacity development needs;
- provide demonstrations, innovations, lessons learned and opportunities for collaboration from around the world.

SPC worked closely with each lead government agency (as identified in the ISG) to organise the workshop including the agenda and logistics. The lead agency identified key stakeholders that should participate. A general format for these workshops was discussed with the ISG that would include:

- a high-level welcome address;
- introduction to DE Pacific;
- policy and enabling environment;
- examples from around the world;
- presentations from each agency on mandate, data gaps and needs, alignment opportunities and capacity development needs.

This provided a general framework ([Appendix 4.2](#)) for each workshop with each country adapting to fit its particular needs and circumstances. A set of reference questions ([Appendix 4.3](#)) was distributed to each country as a guide for developing agency specific presentations that speak to the types of questions we are seeking answers to as part of this needs assessment. While participants within each country could gather in-person for these workshops, due to COVID-19 travel restrictions, international in-person participation was not possible. Video conferencing was used to facilitate each national workshop.

The agencies involved in the national consultation were as follows:

Vanuatu: 3 June 2021

- Ministry of Lands, Geologies, Mines and Water Resources – Lead Agency
- Prime Minister’s Office
- Ministry of Foreign Affairs, International Cooperation and External Trade
- Ministry of Agriculture, Livestock, Forestry, Fisheries and Biosecurity
- Ministry of Climate Change and Planning
- Vanuatu National Statistics Office
- Ministry of Internal Affairs.

Figure 2: Photo of the Vanuatu workshop



Pacific Community (SPC), 2021

Republic of the Marshall Islands (RMI): 11 June 2021

- Office of the Chief Secretary – Lead Agency
- Marshall Islands Marine Resources Authority
- Ministry of Natural Resources and Commerce
- National Disaster Management Office
- Weather Service Office

- Majuro Water and Sewer Company
- Majuro Atoll Waste Company
- Environmental Protection Authority
- Climate Change Directorate
- Marshall Islands Conservation Society
- Ministry of Works, Infrastructure and Utilities
- Marshalls Energy Company
- College of the Marshall Islands
- University of the South Pacific
- Economic Policy, Planning and Statistics Office.

Figure 3: Photo of the Republic of the Marshall Islands workshop



Pacific Community (SPC), 2021

Tonga: 11 August 2021

- Ministry of Lands, Survey and Natural Resources
- Ministry of Tourism
- Ministry of Agriculture and Food, Forests and Fisheries
- Ministry of Health
- Prime Minister's Office
- Ministry of Infrastructure

- Statistics Department
- His Majesty's Armed Forces
- Waste Authority Ltd
- Tonga Power Ltd
- Tonga Communications Corporation
- Tonga Water Board
- Digicel (private telecommunications company)
- Civil Society Forum of Tonga
- Tonga Red Cross Society.

Figure 4: Photo of the Tonga workshop



Pacific Community (SPC), 2021

2.1 Identified needs and use cases

The primary purpose of the national workshops was to better understand the needs of earth observation data in regard to the mandate, objectives and activities of each pilot country's agency. Government representatives were asked to outline how they are currently using geospatial and earth observation data and what priority needs they have within their organisations for how earth observation data can be applied, i.e., use cases.

Based largely on the workshops, supporting materials and meetings with focal country points, Table 1 outlines identified needs and use cases for each country (those marked with "1"). Roughly 50 use cases were identified across 13 thematic areas, and it is expected that this list will grow as the programme further develops and more discussions are had with each country.

Table 1: Identified needs and use cases for Vanuatu, RMI and Tonga

Thematic area	Needs and use cases	Vanuatu	RMI	Tonga
Agriculture	Agricultural census	1		1
Agriculture	Vegetation index – crop detection	1	1	1
Agriculture	Subdivision of agricultural lands to residential areas			1
Climate change	Relocation of coastal communities			
Climate change	Coastal area change	1	1	
Climate change	Coastline change detection	1	1	1
Climate change	Coral bleaching		1	
Conservation	Conservation area change detection	1		
Conservation	Invasive species	1	1	
Conservation	Forest monitoring system	1		
Conservation	Coconut tree counting		1	
Conservation	Wetlands mapping		1	
Conservation	Forest cover change detection	1	1	1
Conservation	Mangroves			1
Disaster management	Volcanic eruptions	1		
Disaster management	Earthquakes	1		
Disaster management	Cyclones	1	1	1
Disaster management	Tsunami	1		1
Disaster management	Inundation modelling/flooding	1	1	1
Disaster management	Hazards mapping	1		1
Disaster management	Droughts		1	1
Disaster management	Digital Elevation Model	1	1	1
Fisheries management	Ocean thermal stresses		1	
Fisheries management	Vessel tracking		1	1
Fisheries management	Fisheries stock assessments		1	1
Geology and mines	Sand resourcing	1	1	
Geology and mines	Geology maps			1
Geology and mines	Soils			1

Meteorology	Rainfall	1		
Meteorology	Cloud cover	1		
National statistics	Environmental Economic Accounting	1		
National statistics	National accounts and Gross Domestic Product	1		
National statistics	Mapping buildings and associated populations	1	1	
National statistics	Household census – cost of household listings	1		1
National statistics	Household census – annual community-based household counts	1		1
Oceans	Turbidity			
Oceans	Phytoplankton			
Oceans	Bathymetry			1
Oceans	Marine surveys			1
Oceans	Effect of sea level rise on maritime boundaries			1
Public health	Disease tracking, response and forecasting			
Reference systems	Geodetic reference systems update			1
Urban development	Zoning and development controls	1		
Urban development	Sharing of cadastral data between departments	1		
Urban development	Land use/land cover mapping and change	1	1	1
Water resource management	Land use influence on degradation of watersheds and water quality	1		
Water resource management	Water quality/flow into marine/lagoon environments	1		
Water resource management	Identification of new water sources	1		1
Water resource management	River morphology	1		1
Water resource management	Groundwater mapping		1	1

Based on the identified needs across countries, the regional priorities were grouped into a two-tier system and can be considered to be early win products.

2.1.1 Tier I

Tier I represents those use cases that were identified across all three countries. These represent the first set of use cases that DE Pacific can consider for product development:

Table 2: Tier I priority areas

Thematic area	Needs and use cases
Agriculture	Vegetation index – crop detection
Climate change	Coastline change detection
Conservation	Forest cover change detection
Disaster management	Cyclones
Disaster management	Inundation modelling/flooding
Disaster management	Digital Elevation Model
Urban development	Land use/land cover mapping and change

As Table 2 describes, primary needs for use cases focus on agriculture, climate change, conservation, disaster management and urban development. Issues related to food security, climate change and disaster management, as well as the interdependencies between these issues, was a consistent theme across countries. Understanding urban sprawl and land use/land cover change was also a key issue.

Based on previous work conducted by both DE Australia and Africa, there is quick win potential for addressing most of these use cases. The UN World Food Programme (WFP) was added to the Interim Steering Group to also support disaster management-oriented use cases in relation to its Platform for Real-time Impact and Situation Monitoring (PRISM). PRISM has already been connected to an open data cube (ODC) in Mongolia. WFP and the pilot countries are interested in evaluating how PRISM can be applied in their countries. As a result, we hope to develop a test case to allow for interoperability between PRISM and DE Pacific for 1–2 pilot countries as part of this first phase.

2.1.2 Tier II

Tier II represents those use cases that were identified in at least two countries. They represent a second set of prioritised needs for the DE Pacific programme that can be evaluated for early win potential based on existing algorithms and partnerships.

Table 3: Tier II priority areas

Thematic area	Needs and use cases
Agriculture	Agricultural census
Climate change	Coastal area change
Conservation	Invasive species
Disaster management	Tsunami
Disaster management	Hazards mapping
Disaster management	Droughts
Fisheries management	Vessel tracking

Fisheries management	Fisheries stock assessments
Geology and mines	Sand resourcing
National statistics	Mapping buildings and associated populations
National statistics	Household census – cost of household listings
National statistics	Household census – annual community-based household counts
Water resource management	Identification of new water sources
Water resource management	River morphology
Water resource management	Groundwater mapping

As Table 3 illustrates, additional use cases have been identified for Tier II priority areas of agriculture, climate change, conservation and disaster management. Several additional categories are now included: fisheries management, geology and mines, national statistics and water resource management. Note, that as discussions with country representatives continue, it is likely that some of the Tier II use cases will transition to Tier I. This is largely due to not all line ministries being available for the national workshops and expert knowledge within SPC of needs across countries.

Most of the use cases identified in Tier II will require either new methods to be developed or research as to where previous methods have been developed outside of a DE environment that can be deployed in DE Pacific. This offers opportunities for the development of new partnerships and innovation led by the Pacific that the rest of the world can leverage. Given the vast areas of ocean in the region known as the Blue Pacific continent, use cases in the marine and fisheries sector will be important and present a unique opportunity for innovations in comparison to other largely land-based Digital Earth and other ODC-oriented programmes.

2.2 General observations

A great deal of appreciation is owed to each of the countries involved in the needs assessment. The meetings were held in-person within each country, but largely facilitated remotely, and therefore, much of the logistics and organisation required for each workshop was left to the individual country, sometimes over constrained time periods. The workshops were well attended with much enthusiasm on this initiative. Across the country workshops, the following statements were consistent:

- **Countries see the value of DE Pacific's capabilities.** This is especially true regarding access to timely data to support policy and decision-making. However, participants need further understanding on the capabilities of a DE system – especially from a user perspective, identifying specifically how governments have used this technology to drive policy, decisions and action.
- **Access to current data is lacking across countries.** Daily data collection and monitoring is important across countries. Therefore, there was recognition that DE Pacific can be beneficial in filling this gap. This held especially true for disaster management use cases. Participants discussed the need for better and more timely data before and after disaster events.
- **Pacific Island nations have limited resources.** Stakeholders identified DE Pacific as a mechanism to scale outcomes linked directly to policy and planning efforts.

- **There is a need to strengthen institutional collaboration and data-sharing.** While progress is being made in countries such as Vanuatu who have developed a geospatial data-sharing policy and Tonga which is developing the Integrated Geospatial Information Framework, current, actionable policy for data sharing is lacking. Stakeholders see DE Pacific as a mechanism to promote better collaboration across agencies, data-sharing, and developing partnerships with the private sector and civil society.
- **Countries value their relationship with SPC as a technical partner.** Given that SPC will be the institutional home for DE Pacific, the trust built between SPC and member countries will be very important for the programme and only seek to accelerate outcomes. More capacity development opportunities are needed from SPC such that countries stay at pace with technology advancements.
- **There is strong political support for DE Pacific across countries.** Countries expressed commitment at the ministerial level in each of the pilot countries. Having readily accessible capabilities through DE Pacific for addressing national development priorities and economic prosperity was well noted.

2.3 Key questions

Through the national consultations a number of consistent questions were identified across countries that are issues the DE Pacific programme needs to consider as it further develops. These questions are not unique to the Pacific as they often occur on data and technology transformation programmes, however, they should be addressed in the context of the Pacific.

- **Resolution.** Stakeholders questioned the level of resolution being made available by DE Pacific versus the higher resolution data that is currently available through commercial vendors. The core data DE Pacific provide would come from the Landsats 7 or 8 (30m) and Sentinel-2 (10m) satellites. Such data are already free and open, but the DE Pacific programme will make these data accessible through a scalable, cloud-enabled infrastructure as analysis-ready-format. The level of resolution needed is very much dependant on the use case. Often, it is not well understood what resolution is required for a given use case with the assumption that higher resolution is always better. The medium resolution data made available through DE Pacific will cover many different use cases and often those that are useful at the national and regional levels (for example, water observations, land use-land cover change, agriculture, flooding coastal change). Higher resolution data are useful where a greater level of precision is required for urban applications (master planning), disaster management (recovery efforts) or transportation. In summary, expectations for what DE Pacific could support should be managed with the understanding that medium resolution data will be able to address most use cases, but not all. Nevertheless, the DE Pacific programme will be exploring partnerships with commercial vendors to potentially make high resolution data available.
- **Cloud cover.** Cloud cover is an issue for island nations across the Pacific. Clear imagery is infrequent as observed by both the Landsat and Sentinel-2 optical satellites and thus radar data becomes very useful because it can penetrate clouds. An analysis conducted by Brian Killough (NASA-CEOS) demonstrates the availability of satellite data for all the SPC countries and territories across each of the three satellites, with Sentinel-1 providing the radar data. As Table 4 illustrates, Sentinel-1 data is available for only the larger islands. This is a key issue that the DE Pacific programme would address with the European Space Agency and European Commission to request Sentinel-1 data being made available for countries where the sensor is not currently turned on.

Table 4: Availability of Landsat 8 and Sentinels 1 and 2 satellite data across Pacific countries and territories

Country	Landsat-8	Sentinel-2	Sentinel-1
American Samoa	Yes	Both	1A
Cook Islands	Yes	Both	No
Fiji	Yes	Both	Both
French Polynesia	Yes	Both (mix North/East)	Both (few regions)
Guam	Yes	Both	No
Kiribati	Yes	Both	No
Marshall Islands	Yes	Both	No
Micronesia	Yes	Both	No
Nauru	Yes	Both	No
New Caledonia	Yes	Both	1B
Niue	Yes	Both	No
Northern Mariana Islands	Yes	Both (South only)	No
Palau	Yes	Both	No
Papue New Guinea	Yes	Both	Both
Pitcairn Islands	Yes	Both	No
Solomon Islands	Yes	Both	1B
Samoa	Yes	Both	1A
Tokelau	Yes	No	No
Tonga	Yes	Both	No
Tuvalu	Yes	Both	No
Vanuatu	Yes	Both	Both
Wallis and Futuna	Yes	Both	No

Timeliness of data availability. Disaster management and response is a priority use case across all countries. When a disaster occurs, data is needed immediately to understand the scale, affected areas and coordinate response activities. However, currently, the required data are often not available in a timely manner, and often, mechanisms such as the [International Disasters Charter](#) do not provide data as quickly as needed. The advantage of having a DE Pacific infrastructure in place is that it will be an operational system that makes new data available as these are collected by the satellites, along with all the historical archives. As a result, an understanding of both before and after an event will be possible. Mechanisms such as the charter will still be needed to make high resolution data available, and as previously mentioned, the DE Pacific programme will also explore partnerships for making these high resolution data available.

- **Regional ownership.** Stakeholders wanted to better understand how the needs of countries would be prioritised for products and services that the DE Pacific programme would make available. For one, the intent of this needs assessment is to better understand the needs and priorities across countries. The priorities identified through this assessment will help formulate a near-term work programme for the development of early win products and services this year. In addition, the current governance structure of the DE Pacific programme (Interim Steering Group) includes country representation from Fiji, Republic of the Marshall Islands, (RMI), Tonga and Vanuatu. As the programme further develops, a more comprehensive governance structure will be developed and co-designed with country representatives to ensure local knowledge, expertise and needs are incorporated into the decision-making process for DE Pacific.

- **Data sovereignty.** Countries wanted to better understand how data produced within a country and its intellectual property remains with the country. DE Pacific will make globally accessible data available to all countries. The objective is to not share country-level data with others unless there is a specific agreement with that country to make such data available. Furthermore, when country-level data needs to be combined with satellite data made available through DE Pacific, interoperability between systems will allow users to bring such data together without having to share the internal datasets. When the programme is formally launched, a data governance model will be developed that defines the rules for how data will be addressed by DE Pacific, including issues related to privacy, intellectual property, appropriate uses, accessibility and openness and others.
- **Redundancy.** Stakeholders expressed the need to align to existing programs, initiatives, projects and systems where possible rather than reinventing the wheel or adding redundancy. Further, stakeholders expressed the need for interoperability as opposed to redundancy. This very much aligns with the principles of DE Pacific, which will aim to add value to existing programmes and initiatives, while creating new innovations to support country needs and priorities.
- **Capacity development.** The need for capacity development on the use of geospatial and earth observation data and technology was expressed across countries. This included developing skills in R (the programming language), developing machine learning algorithms, using open-source software and using light detection and ranging (LiDAR) and other remotely sensed data. The extent to which capacity development will be expressed will be explored further in depth later this year. A number of members of the Interim Steering Group have direct experience in developing capacity development programmes including the University of the South Pacific, CEOS, Geoscience Australia and Group on Earth Observations (GEO). In addition, training modules previously developed in other DE programmes and those under current development by partner organisations can be leveraged to provide some early wins.

2.4 Policy alignment

In order for DE Pacific to be relevant in terms of policy and support the development of products and services directly aligned to national and regional priorities, each workshop included a session to discuss relevant policy mechanisms. The following instruments provide a policy framework for DE Pacific to support:

2.4.1 National

- **Vanuatu National Geospatial Data Policy (NGDP).** Vanuatu has recognised the importance of geospatial data to support its national development and sustainability efforts. In addition, it has recognised that the collection and collation of geospatial data at a national level has been fragmented. The NGDP creates an enabling environment for the centralisation, coordination, management and dissemination of geospatial data. The NGDP is grounded in six strategic areas: (i) governance; (ii) standardisation; (iii) data management; (iv) security; (v) support; and (vi) infrastructure.
- **Vanuatu 2030 – The People’s Plan.** The National Sustainable Development Plan and Monitoring and Evaluation Framework serves as the country’s highest-level policy framework. It aims to better link policy and planning to the limited resources of government and outlines the national sustainable development goals and policy objectives in order to translate the 2030 national vision of a stable, sustainable and prosperous country into specific priorities to be actioned, and provides a sound framework to track and report progress against.

- **RMI National Adaptation Plan (NAP).** The NAP is the government's response to changing climate impacts and the situation of atolls and their communities. It is the national mechanism to support sectors and is overseen by the government's Tile Til Eo climate strategy coordination mechanism. Well-being and economic and livelihood activity are among the fundamental bases of near-term and intermediate-term management of climate change effects. Governance, policy and traditional rights and norms are addressed in the near term to find pathways in the long term.
- **Tonga National Development Strategic Framework.** This is the main policy vehicle that guides the development priorities for Tonga. A key outcome that DE Pacific can support is the development of a dynamic, knowledge-based economy. Additional opportunities for alignment include the development of public-private partnerships for economic growth and providing reliable information and using communication tools and technology to support decision-making.
- **Tonga Integrated Geospatial Information Framework (IGIF) Country Action Plan (CAP).** Under the auspices of the United Nations Committee of Experts on Global Geospatial Information Management, Tonga is one of the first countries in the Pacific region to develop its CAP. The latter incorporates nine strategic pathways: (i) governance and institutions; (ii) policy and legal; (iii) financial; (iv) data; (v) innovation; (vi) standards; (vii) partnerships; (viii) capacity and education; and (ix) communication and engagement. The vision of the CAP is to increase the quality of life of Tongans supported by accessible, accurate and reliable integrated geospatial information; to do so through coordination and collaboration of integrated geospatial information; and to leverage it for sustainable solutions to national needs and opportunities.

2.4.2 Regional

- **2050 Strategy for the Blue Pacific Continent.** In 2019, forum leaders endorsed the development of the strategy noting that escalation to climate change-related impacts coupled with the intensification of geostrategic competition is exacerbating the region's vulnerabilities. Through a multi-stakeholder engagement process, the strategy is to be delivered at the Leaders Forum in 2022. The vision for the 2050 strategy is as follows:
 - In recognising the undeniable connection Pacific peoples have with their natural resources, environment, culture and livelihoods, their deep concern for urgent and immediate action to combat the threat of climate change and their shared stewardship of the Pacific Ocean, our vision is for a resilient Pacific region of peace, harmony, security, social inclusion, equity and prosperity, that ensures all Pacific people can lead free, healthy and productive lives.
- **Pacific Geospatial and Surveying Council (PGSC).** The PGSC is an independent regional body advancing geospatial and surveying standards and capacity. It was established on the margins of the Pacific GIS/RS User Conference in November 2014 and is governed by the PGSC Charter endorsed by 11 Pacific Island governments.
- **GEO Pacific Island Advisory Group (PIAG).** The PIAG has been established within the Group on Earth Observations, which is an intergovernmental organisation with over 100 member countries promoting the effective use of earth observation data. The PIAG establishes a mechanism for Pacific Island countries and territories to voice their concerns and priorities especially in light of increasing exposure to disaster risk, climate change and sustainable development challenges.
- **Pacific Community Strategic Plan 2021+.** The Pacific Community's forward-looking, strategic plan that will guide SPC's work for the next 10 years is currently being drafted. The thematic areas align with the 2050 Strategy for the Blue Pacific Continent.

3. Next steps

This needs assessment and the consultations with pilot countries serve to better understand the needs and priorities across countries in the development of the DE Pacific programme. The use cases identified in Tier I and II will be further rationalised with each pilot country and mapped against existing algorithms and Jupyter Notebooks from other programs to identify quick win opportunities.

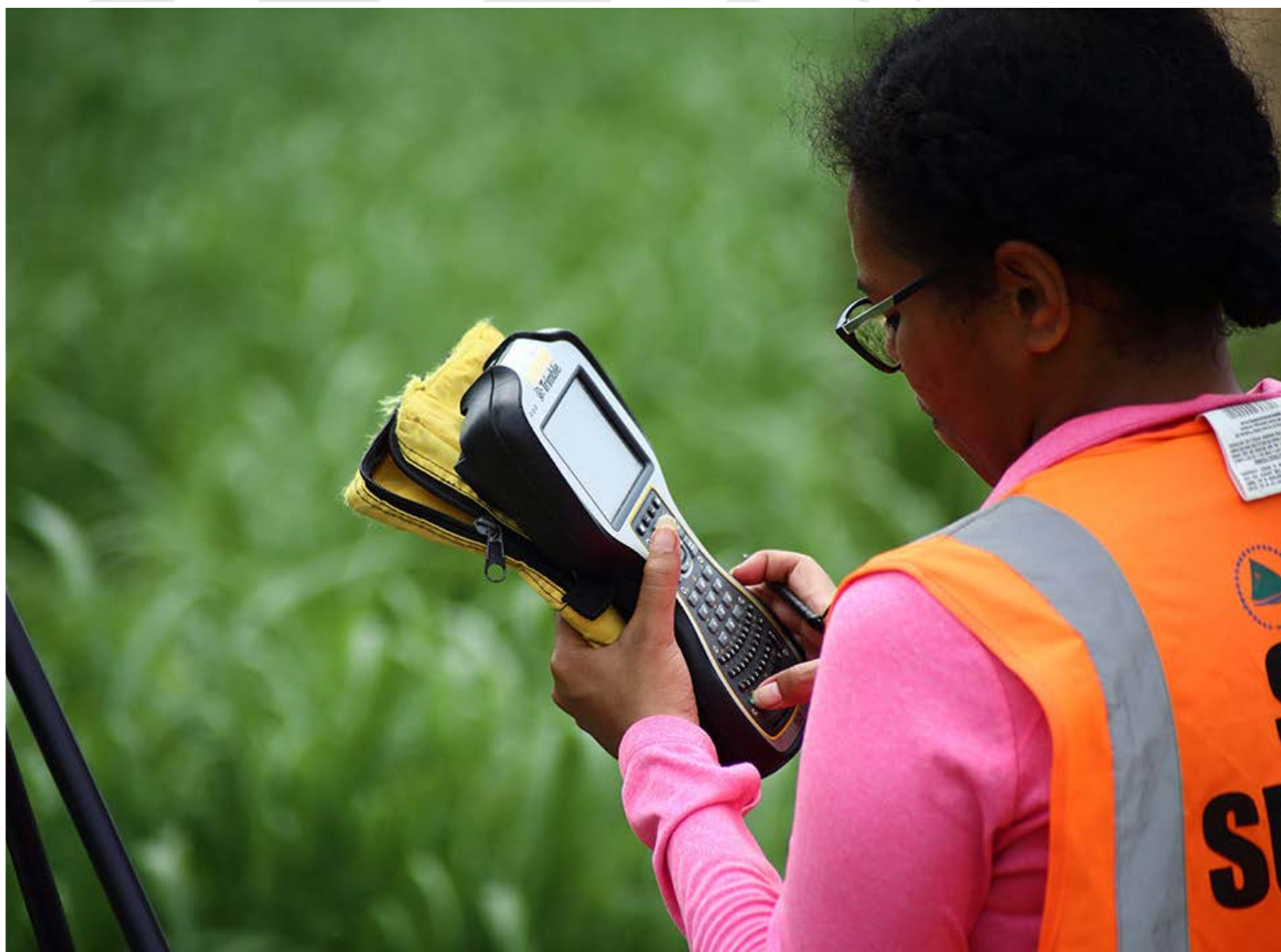
In parallel, SPC has been conducting a competitive search to identify the right technical partner to support the development of a prototype infrastructure for DE Pacific. See [Appendix 4.4](#) for the scope of this exercise. The aim of the prototype is to develop a minimum viable product (MVP) that demonstrates the core functionality and data of an operational DE Pacific infrastructure. Core satellite data will be made available in an operational format allowing users to view and explore these data via an intuitive interface, while using an analytical environment to run and develop algorithms. This prototype will be used to develop early win products against the identified priorities in Tiers I and II.

It should be noted that the direction for the development of the DE Pacific infrastructure may differ from other DE programs due to further advancements in the technology. Open Data Cube and Pangeo/Planetary Computer are being evaluated as well as cloud infrastructure across Microsoft, Amazon and Google. It is hoped that a final solution will be deployed that offers the best capabilities for the Pacific given its needs and requirements, and would be done so in a scalable way to make data and products available for the entire region. It is expected that the MVP will be available around November 2021.

In addition, the business case for DE Pacific will also start developing. This will articulate the broader needs for developing a DE Pacific programme within SPC addressing the institutional, political, technical, financial and capacity development requirements needed to establish an operational and long-term programme. Further consultations with SPC, member countries and territories and partners will be required to develop the business case, which is expected to be completed by the end of this year. In parallel, the project team will also be exploring opportunities for donor support and technology and capacity-development partnerships.

In the meantime, further consultation and reflections will be conducted with pilot countries and other member countries and territories. The project team is considering two key workshops or webinars:

1. An end-user-focused webinar that brings together a set of speakers with direct experience of working with DE who can discuss the challenges and opportunities and what this has meant for transforming data into decisions, policy or other actions;
 2. A workshop to more broadly discuss the outcomes of the needs assessment, provide an update on the development of the MVP and discuss capacity-development requirements in greater depth.
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4. Appendices

Appendix 4.1 Interim Steering Group: terms of reference

The Interim Steering Group (ISG) is being established as an advisory body tasked with supporting and guiding Phase I of DE Pacific to include:

- development of a needs assessment that reflects priorities across four pilot countries (those included in the ISG) and the region;
- development of a prototype Open Data Cube infrastructure for the region;
- development of early win products for the pilot countries;
- development of a business case that reflects the institutional, political, technical, financial and capacity-development requirements needed to launch a sustainable DE Pacific programme for the region;
- regional and global outreach to gain political buy-in and donor support.

The ISG will be multi-stakeholder inclusive of representative government institutions across the Pacific, the private sector and other key organisations within the broader earth observations community. The Pacific Community (SPC) as the founding co-chair will invite members to initiate the ISG. A country representative should be selected as the second co-chair. Thereafter, additional membership can be determined based on consensus.

Founding members of the ISG include:

1. Pacific Community (SPC) (Co-Chair);
2. Ministry of Lands and Natural Resources, Tonga (Co-Chair);
3. Department of Lands and Survey, Fiji;
4. Office of the Chief Secretary, Republic of the Marshall Islands;
5. Ministry of Lands and Natural Resources, Vanuatu;
6. University of the South Pacific;
7. Committee on Earth Observation Satellites;
8. Geoscience Australia;
9. Group on Earth Observations;
10. National Oceanic and Atmospheric Administration;
11. UN World Food Programme.

Terms of reference:

- provide overall advice and guidance towards the successful completion of Phase I – needs assessment, early wins and business case;
- provide recommendations and introductions to key stakeholders;
- support development of buy-in from key institutions and politically with countries and territories across the Pacific;
- provide technical expertise, alignment with key institutions and policy guidance;
- support the development of a permanent governance structure;
- support broader outreach and communication needs;
- support funding efforts as needed.

Beginning in May 2021, the ISG will meet on a bi-monthly basis or more frequently as needed. Discussions will be open to all members facilitated by the co-chairs, who will also be responsible for achieving consensus and any major decisions. The ISG will operate in an inclusive, agile and productive manner.

Appendix 4.2 Guidelines and process for organising national workshops

1. Select date for workshop (early to mid-June);
2. Country focal point to identify priority set of ministries, departments and agencies (MDAs) that should be involved in the workshop. Those involved should be primary contributors and users of DE Pacific and earth observation data. Suggestions include:
 - a. Prime Minister or President's Office;
 - b. Agriculture;
 - c. Fisheries;
 - d. Climate Change;
 - e. Statistics;
 - f. Land and Natural Resources;
 - g. Environment;
 - h. Water;
 - i. Disaster Management.
3. SPC will provide an invitation letter for each selected MDA;
4. Focal point, in consultation with MDAs and SPC, to identify representatives to give presentations on the policy and enabling environment – policies, regulations and standards in place or where gaps have been identified that address:
 - a. national development priorities;
 - b. sustainable development agenda;
 - c. regional or global policy frameworks;
 - d. production, sharing or use of data;
 - e. data quality, standards, security or interoperability.
5. Focal point, in consultation with MDAs and SPC, to identify representatives from each MDA to give a presentation on data challenges and opportunities:
 - a. institutional background – mandate, core objectives and priorities;
 - b. data gaps and potential use cases – what data gaps have been identified already? What use cases are needed? How is earth observation (EO) data currently being used or how could it be used?
 - c. alignment opportunities – what other projects, programmes or initiatives have been implemented or are under way that DE Pacific should align to?
 - d. capacity development – do you have geospatial or remote sensing capacity in your organisation? What capacity development needs are there for the effective use of EO data, products and services?
6. SPC and focal point to ensure presenters have these guidelines and detailed questions for reference;
7. SPC will work with focal point to develop agenda and conference facilities/online video;
8. SPC to set up any advance meetings needed with country focal point and MDAs as required to provide background and prepare for the workshop.

Appendix 4.3 Needs assessment reference questions

The following document provides a set of reference questions for capturing background information related to the needs assessment being conducted for DE Pacific. These questions address institutional, policy, data and capacity development issues related to the effective use of EO data, products and services in the Pacific region, and more specifically, in your organisation. These questions are meant as a guide for presenters to consider as they develop their presentations for the national workshop. The SPC team will be following up on these types of questions either during the workshop or soon thereafter. Again, these are for reference only and it is not expected that every element be included in the presentations.

Institutional

1. What is the mandate of your institution?
2. What are the main problems that your organisation addresses?
3. Do you have staff or a department focused on the use of geospatial and EO data?
4. What is the perceived value of having a digital infrastructure in place serving the Pacific with free and open satellite data? Are there specific incentives needed to drive usage and progress?
5. Is there management support at an organisational level for this initiative?

Policy

6. What national, regional or global policy frameworks, which address national development priorities or sustainability, have you adopted or are in progress?
7. Has there been any policy gap assessment done for where further policy development is needed?
8. Do you have any policies, regulation or procedures for how data is shared across government, the private sector or any other sector?
9. Do you have any policies in place related to geospatial, EO or open data?
10. Are there regulations or standards in place regarding data governance or privacy?

Data

11. How is EO data currently being used in your organisation?
 - a. If it is being used, which satellite data are you using?
12. What types of use cases are you trying to address where EO data could be helpful (disaster management, fisheries management, deforestation, water availability, flooding, urban development, and so on)? Be as specific as possible.
13. To address the above use cases, do you have the data you need? If not, what is missing?

14. Are there high-priority projects under way or planned that have satellite data requirements that we should be considering?
15. Do you have other projects, programmes or initiatives that you have or are actively working on that we should leverage or align with in some way?
16. Who are the primary users of the data you produce?
17. What have been your challenges accessing and using satellite data in the past?
18. Do you have partnerships with other organisations or companies that lead to data development or distribution?

Capacity development

19. Do you have trained geospatial scientists, remote sensing experts or geographic information system staff that will be able to make effective use of DE Pacific?
20. Who is your target audience for training?
21. Do you know what type of training and capacity development is needed (ranging from technical users to decision-makers)? For example, introductory remote sensing, cloud computing, data analysis or interpretation for policy and decision-making.
22. Do you expect your organisation to be a user of products and services developed by DE Pacific only, or do you expect to create and develop your own products and services internally?
23. How do decision-makers currently use data-driven products to inform decisions or policy? Is there a particular format in which they like to see the information?
24. How do you inform the public about data-informed issues?

Appendix 4.4 DE Pacific core data and minimum viable product (MVP) platform

Core datasets

The following datasets should be accessible by DE Pacific users through a cloud computing environment:

- Landsat-7 (2000+) and Landsat-8 (2014+);
- Sentinel-2 (2017+);
- Sentinel-1 (where available, 2017+);
- ALOS PALSAR Annual Mosaics (2007-2010, 2015-2020);
- Copernicus DEM.

MVP functionality

The prototype infrastructure will provide core data and basic functionalities for SPC member countries and territories. Functionality will be made available to demonstrate data access, exploration, regular updates and analysis. The intent is to demonstrate capabilities and enough of a user experience so that the value of a fully functional DE Pacific infrastructure can be understood by users. As such, basic functionality should include:

- data pipelines to the core datasets with regular updates as the new satellite data becomes available;
- a Jupyter Notebook environment that provides access, manipulation and running of a set of notebooks allowing for general analysis needs (for example, normalised difference vegetation index, cloud masking, vegetation change) and more specific, use-case oriented applications (for example, water observations from space, coastline change, urban extent). The selected notebooks should:
 - allow for analysis across Landsat and Sentinel data;
 - have been tested and accepted by the user community;
 - align to the needs and priorities identified by the Pacific Community.
- a map viewer allowing for viewing, exploration and basic, map-based analysis of datasets;
- documentation allowing users to understand what data is available and how the platform can be used.



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