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Earth Observation Technologies for Improved Access to Climate Finance*

The Role of Data and Information

Summary
Average global temperature is currently estimated to be 1.1°C above pre-industrial times. Based on existing trends, the world could cross the 1.5°C threshold within the next two decades and the 2°C threshold early in the second half of the century.[1] The Commonwealth is home to 2.4 billion people in 54 member countries, out of which 32 are small states. Members that are developing countries and island nations are the most vulnerable to the consequences of climate change, for example, through food insecurity, rising sea levels, exacerbation of floods and droughts, and deteriorating ecosystems.

To prepare for the threats and address the impacts of climate change, developing countries and island nations require climate finance to meet their national plans for adaptation and mitigation actions. Accessing climate finance, however, can be a significant undertaking for countries with limited capacity to produce climate finance proposals in a format that secures funding from the major international and regional climate funds.

There are challenges in producing sufficient evidence, justification and climate rationale for proposed interventions. Obtaining the necessary information to identify climate vulnerabilities, estimate change and monitor the impacts is very difficult. Quality and unbiased data are therefore vital for making decisions in these areas. Fortunately, advances in technology are resulting in the emergence of more and enhanced forms of data.

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Commonwealth CLIMATE FINANCE ACCESS HUB

The Commonwealth Secretariat through its Commonwealth Climate Finance Access Hub (CCFAH) is providing technical assistance to Fiji, Solomon Islands and Vanuatu in utilising the geospatial based CommonSensing platform for enhanced access to climate finance.

https://thecommonwealth.org/climate-finance-access-hub

Satellite data can be used for calculating baselines and reference conditions and for measuring the direction and rate of change for projects relating to sea-level rise, flooding, land degradation, fisheries, coastal protection, food security, exclusive economic zones (EEZs) and marine agreements, for example. However, unless these earth observation (EO) data and information are made accessible and understandable for member countries, and there is the capacity to utilise the data to source climate finance for projects and programmes, then the most vulnerable nations will remain at risk.

CommonSensing is an innovative project that is assisting the Commonwealth Pacific small island developing states (SIDS) of Fiji, Solomon Islands and Vanuatu in making these data and information readily accessible, along with the capacity building for technical staff of national government agencies in utilising the geospatial-based CommonSensing platform for developing bankable climate finance proposals. The provision of data and technical assistance to support the design of evidenced-based climate change proposals with concrete justifications can enhance access to climate finance. Improved use of data can contribute to turning country priorities and Nationally Determined Contribution (NDC) commitments into climate finance investment plans and projects, thereby addressing the financing gap where the implementation of many NDCs is conditional on external financing being received.

Problem statement

Access to climate finance is a challenge for many developing countries, including for small island developing states. Projects remain in the pipeline as they fail to provide sufficient justification for the climate rationale to receive funding. Resources and capacity to provide the required evidence of that rationale are often constrained in developing countries, resulting in fewer bankable climate finance proposals being successful.

This discussion paper proposes the use of satellite remote sensing (SRS) and earth observation (EO) data, information and applications (see Box 1) as a means to manage and address this problem and enhance the development of robust climate finance proposals and enable better access to climate finance streams.

Background

The impacts of climate change are evident and particularly apparent in small island developing states (SIDS), least developed countries (LDCs) and other vulnerable states, with costs to tackle these impacts being very high. It is estimated that by 2100, sea-level rise alone could incur economic costs of US$14 trillion globally.[2]

The decisions these countries make prior to and during events like cyclones or tropical storms are critical to adapting to, and surviving, the devastating climate change impacts. Robust preparation for climate related disaster is aided by satellite data. It aids the understanding of when and where disaster will strike, as well as the swift, co-ordinated response needed to initiate recovery. It can assist in the assessment of: damage to critical infrastructure, for example, mapping damaged roads and bridges; landslides, erosion and flooding; and of displaced person/refugee camp growth/expansion. It can also improve the speed of reconstruction and recovery, so that funds are not delayed and can be more quickly disbursed towards climate resiliency.[3] However, countries that are at risk from these extreme events are often operating with access to only limited climate and weather data, and limited climate observations, projections, impact models and vulnerability assessments, for example.

Obtaining the necessary information to identify climate vulnerabilities, estimate change and monitor the impacts is difficult. This increases the risks of decisions being made that are not sufficiently informed or justified, and that are generally affected by the need to prioritise competing economic development needs or

Box 1. What is earth observation (EO) and satellite remote sensing (SRS)?

SRS is a broad term referring to observations made using any form of remote sensing technology from space. EO, a subset of satellite remote sensing, is 'the process of acquiring observations of the Earth's surface and atmosphere via remote sensing instruments', with the data gathered being typically imagery. There are a variety of digital techniques used to generate images that allow for a range of data to be collected under various circumstances (cloudy, night-time, etc). Typically, EO gathers data on the physical chemical and biological systems of the planet, and space-based observations can be supplemented by ground-based data collection.

Source: Newcomers Earth Observation Guide, available at: https://business.esa.int/newcomers-earth-observation-guide#ref_1

the limited human and financial resources that are available. This can be seen, for instance, where available resources are diverted towards and overburdened by the ongoing COVID-19 pandemic and the associated transport, trade and supply chain interruptions.

If policy-makers, decision-makers, project designers and technical support staff working in various ministries do not have this data and information, then it is difficult for them to develop the requisite policies, projects and actions required to tackle climate change. Quality data to form an evidence base are therefore vital for making informed decisions. Fortunately, advances in technology are resulting in the emergence of more forms of data to support this kind of decision-making.

Satellite EO data can be used broadly and with other systems and applications, at micro and macro scales, because it is reliable and can be standardised, obtained regularly and analysed easily. Data can be acquired with different temporal (hourly, daily, weekly, monthly), spatial (metres to kilometres) and spectral (multi v hyper) resolutions, and from a particular period in time. EO data is also the only source for many of the Essential Climate Variables (ECVs) (see Table 2) and can continue to be collected remotely during times of crises, like during the aftermath of super cyclones Amphan and Harold, when manual data collection may be disrupted. These advances can provide the evidence necessary to support and justify effective climate action.

However, if developing countries, like Pacific SIDS, cannot access and benefit from EO data, information and applications to develop bankable climate finance project proposals, current inequities between these countries and others are likely to continue due to suboptimal decision-making.

The process of revising and implementing Nationally Determined Contributions (NDCs) – the climate plans set out by each country under the Paris Agreement – provides a crucial window for developing countries like SIDS to take on the use of EO tools. When the data generated are made accessible, this can aid the transformation of NDCs to investment plans, through which countries can implement national aims.

The CommonSensing project is an example of the innovative use of EO. It focuses on developing national capacities for longer-term sustainability and business continuity by providing partner countries with the knowledge and skills sets for institutionalising evidence-based decision-making. This can help to co-ordinate financing for implementing NDC aims, but additionally the project seeks to improve evidence-based decision-making in disaster preparedness and response, as well as assessing climate risks.

CommonSensing is an example of the innovative use of EO.

The project does this by better utilising EO technologies and remote sensing data, using local and global data sets to deliver an Analysis Ready Data (ARD) solution. These products are combined with capacity building to facilitate improved access to climate finance. ARD are pre-processed satellite data that have been organised in a format ready for easy analysis through free and open-source data web portals and mobile applications, without the need for additional processing by the user. Governments, supported by embedded Commonwealth national climate finance advisers, are able to then use this data to produce higher-quality applications to major climate funds.

> 'The striking feature of the CommonSensing project is it has well positioned the Pacific islands with the requisite capacity for effective assessment and monitoring of climate and related socio-economic variables which translate in defining and crafting meaningful climate financing projects for the region.'
>
> Othniel Yila, PhD, Commonwealth National Climate Finance Adviser (CNCFA), Zambia (July 2020 to present), formerly CNCFA, Tonga (April 2018–June 2020)

This discussion paper examines the current use of EO in accessing climate finance, looking at the role the major funds think that EO can play. The paper draws out the gaps where major climate funds see poor use of the technology and links this to specific sections of the project cycle where the use of EO can buttress other forms of evidence-based project justification.

To facilitate discussion, the paper is structured around guiding questions:

- What is the current status of accessing and using EO data in climate finance applications?
- How do the major climate funds evaluate the current use of EO data?
- How can EO data improve the 'bankability' of project proposals?
- How is EO data able to buttress decision-making?
- How has the role of EO data changed since the global COVID-19 pandemic began?

EO data and technology and successful climate finance applications

Funds provided for climate action are overwhelmingly channelled into mitigation projects, averaging 66 per cent of total reported public climate finance in 2017–18.[4] Funding for adaptation – which is typically the priority for SIDS, LDCs and other vulnerable countries as they seek to protect their populations from the impacts of climate change – is constrained. Moreover, within this smaller pool of funding, in 2017–18 only an estimated 20.5 per cent of bilateral climate finance went to LDCs and 3 per cent to SIDS.[5] Within the major climate funds, projects in SIDS are 'underrepresented' throughout the stages of project pipeline development, with only 12 per cent of the funding proposal pipeline in the Green Climate Fund (GCF) by October 2020.[6]

Climate change and natural disasters are impacting Commonwealth member countries and especially SIDS in many ways, affecting different sectors of national economies to different magnitudes. Determining the particular vulnerabilities and routes to resilience in those sectors enables countries to seek targeted climate finance to build capacity and address the impacts of climate change.[7] To do so, countries need to be able to identify and prioritise the risks and provide a measurement of the impact of climate change on different sectors and levels of vulnerabilities therein. The data provide an evidence base for justifying an application for funding. Where there are gaps in the data, solutions need to be found, along with ensuring that there is sufficient institutional and human capacity to utilise the data effectively.

What is the current status of accessing and using EO data for climate finance applications?

In CommonSensing partner countries, there is significant scope to improve access to and use of EO data in accessing climate finance. Uptake of these tools in other countries is especially uncommon in low-income countries, as there are many barriers preventing their full utilisation.

The issue of capacity to collect or access EO data is an important variable in understanding the use of this data. The preliminary baseline evaluation of the CommonSensing project found that, within the project countries, the expertise in geospatial and remote sensing data collection and analysis was limited to a small number of people across separate organisations. Furthermore, the equipment being used could be obsolete and of insufficient capacity.

In addition, capacity to then process and use geospatial and remote sensing data is important. As found in the same baseline evaluation, such data was rarely used for project planning and decision-making, partially because senior officials were not adequately engaged, resulting in scarce government budget support. This limited capacity was also cited in other studies, where climate finance fund requirements around project feasibility, design and management are higher than the capacity of each SIDS.

Using EO in more innovative ways could ensure premiums are targeted and customised to specific environments and conditions.

The outcomes of a Pacific Commonwealth Scientific and Industrial Research Organisation (CSIRO) workshop on an Earth Observation Platform to Support Pacific Island Nations' Environmental, Climate and Livelihood Needs in 2018 reflected some of these issues at a broader regional level.[8] During this forum, country representatives recognised that thematic needs in the region could benefit from an improved ability to exploit EO data. These thematic areas were identified to include disasters (risk management and response), planning (infrastructure, land use), environmental monitoring (oceans, terrestrial, biodiversity, planning), food security (drought, freshwater), and national security (sovereignty, law enforcement). Notably, the focus remained on accessing and using data for monitoring and decision-making, rather than as a tool to explicitly unlock improved access to climate finance.

EO data have a traditional role in financial products such as insurance and reinsurance: companies observe the environment of the insured products to evaluate risk and assess damage after a catastrophe.[9] If data supporting climate-linked insurance show that extreme weather events are becoming more frequent and intense, insurance premiums would increase. However, using EO in more innovative ways could ensure premiums are targeted and customised to specific environments and conditions, more accurately pricing premiums across different contexts. EO data are both used to develop more granular insurance products as well as fixing the cost of the products; when used correctly they can manage risk and exposure more efficiently.[10]

In the same way that improved data sources can help to price risk more efficiently, EO data could play a similar role in attracting more blended finance products to a concept. By improving the quality of information available, risk information asymmetry is reduced, and the private sector may be more willing to participate in climate action.

One notable example of the beneficial use of EO and SRS technology is in Costa Rica's application to the Global Environment Facility (GEF) for the full-sized project 'Conserving Biodiversity through Sustainable Management in Production Landscapes in Costa Rica', approved in 2016.[11] The project sought to mainstream biodiversity conservation, sustainable land management and carbon sequestration objectives into Costa Rica's production landscapes and urban biological corridors. Costa Rica used EO to:[12]

- provide evidence in justifying the project, precisely explaining land-use change over time and providing data on reduction of forest cover in terms of km^2 of fragmented secondary forest and secondary forest;
- support the project as a form of co-financing, as the National Territorial Information System is such a core decision-making tool for land-use planning;
- facilitate monitoring of land-use change over the duration, which is used to track the success of the project; and
- demonstrate innovation, sustainability and scaling up potential.

Crucially, the use of EO was appreciated by the GEF Scientific and Technical Advisory Panel (STAP) in its review of the proposal[13] and it made suggestions for further uses of mapping to strengthen the application:

> *'STAP is pleased the project aims to improve the geo-referencing capacity of the National Territory Information System (SNIT) to monitor land use change in private land under agricultural production.*
>
> *Satellite imagery will complement ground-based methods and data and help improve monitoring and policies on biodiversity conservation and sustainable forest management in the two target sites. STAP encourages UNDP and Costa Rica to continue sharing their learning on the use of remote sensing methods and data for the purposes of conserving biodiversity and improving forest management.*
>
> *... The project developers may want to include a map that specifies the provisions and demand of biodiversity and ecosystem services based on their indicators. A spatial distribution of the ecosystem services would be beneficial for monitoring purposes, assessing the value of the ecosystem (for example, demand of an ecosystem service is dependent on its spatial characteristics, such as number of downstream water users), and developing policies.'*

In this Costa Rican example, the utilisation of EO data to provide evidence of the country's needs and also as a proposed tool for implementing and monitoring programme outcomes, resulted in appreciation from the STAP at the review stage and ultimate success in securing approval for this full-sized project. Costa Rica has invested heavily in building skills and tools that facilitate the use of EO[14] and there are many lessons that can be learnt in other countries seeking robust tools like EO and SRS to understand and evidence the changing climate around them.

How do the major climate funds evaluate the current use of EO data?

Major climate funds, such as the Global Environment Facility, Green Climate Fund and Adaptation Fund, require strong justification and climate change-focused rationale for approving project proposals. These funds have been explicit about the role of EO in this in the different ways outlined below.

> **Major climate funds require strong justification and climate change-focused rationale for approving project proposals.**

The Global Environment Facility (GEF) has recently increased the guidance provided to GEF implementing agencies and their partners to make best use of EO data and technology. This builds on a change in fund application requirements in 2017, when the Project Information Form (PIF) began to require that project proponents provide a map and geo-coordinates of the project's location. Since then, the GEF has recognised that a PIF map could benefit from being integrated with information derived from Earth observation, but there remains limited guidance on how this information should be provided. In 2020, the Scientific and Technical Advisory Panel (STAP) developed a primer and technical guide to illustrate how these data and tools could be used, and guidance on how to meet the PIF requirements.[15]

As noted in the evaluation of the use of EO technology and data in GEF implementing agencies, the application of such technology tends to be 'one-off' and project specific, with a variety of approaches taken to address similar environmental assessment and monitoring challenges.[16] STAP notes that where GEF agencies (as opposed to national entities) have a centralised system that systematically captures and stores project information, the use of geospatial data has increased. Regularising use of EO data and improving understanding of which approaches work well in different scenarios could enhance the pool of evidence available for justifying finance proposals, as well as potentially reducing the time spent under review as common methods to address familiar challenges emerge.

The Independent Evaluation Office has recommended that the GEF makes greater use of spatially explicit data for projects addressing protected areas, biodiversity and land degradation, and more precision in recording and reporting project location for monitoring and evaluation of progress, results and sustainability.[17]

The Green Climate Fund (GCF) has not produced explicit guidance on the use of EO data and technology, unlike other funds. However, in various stages of the project development cycle, the climate rationale underpinning a project must be evidenced. In adaptation projects, this means identifying the climate impacts, exposure and hazards resulting in climate risks.[18]

The GCF Independent Evaluation Unit (IEU) has noted the need for strong baselines, as it has found it difficult to evaluate some projects due to weak baseline data. These weaknesses include incomplete, inconsistent or unclear baseline information, such as the unpredictability of flood frequency and magnitude.[19] It also noted the benefits of collecting data from monitoring and evaluation systems, such as EO, in that it is less resource intensive compared to stakeholder consultation. The IEU identified, as an example of their application, that satellite data can be used to analyse the effect of the rehabilitation of mangroves on storm buffering.[20]

The IEU uses Geographic Information System (GIS) data to improve evaluations by immediately and independently collecting and validating information from projects for environmental and socioeconomic analysis on the ground. For instance, it uses GIS data to carry out hotspot analysis (a spatial analysis and mapping technique), and inverse distance weighting interpolation (which estimates unknown values).[21]

The IEU has recommended that the GCF consider the establishment of an internal innovation hub focused on early-stage climate innovations to support high-risk investments in small and untested, but innovative, concepts that have the potential to scale up and/or be transformational.[22] The use of EO and the CommonSensing project could provide lessons or serve as a test case for this type of innovation.

The Adaptation Fund's own Second Phase evaluation, published in 2018, found similar weaknesses in using data and evidence to provide a strong climate rationale for the intervention. The evaluation found that 'more than half of the proposals presented climate change scenarios broadly without clearly linking proposed interventions and specific risks or climate drivers, and one-third of proposals lacked evidence and baselines relating to local climate risks and impacts. While applicants may be constrained by the lack of available data, these gaps were not systematically identified and acknowledged in the proposals'.[23] The evaluation identified that 'there is room for projects to further strengthen the adaptation rationale by improving the presentation of evidence (or gaps in evidence) more clearly and demonstrating how the proposed adaptation measures address risks associated with relevant climate drivers'.[24]

Without explicitly referencing EO data or technology, the application of these techniques could fill evidence gaps relating to baselines, climate rationale and the provision of robust evidence.

How can EO data improve the 'bankability' of proposals?

The 'bankability' of a project originated as a term in the finance referring to a return on investment. However, within the international climate finance space, the term is also often used interchangeably with words like 'fundability' and 'eligibility', especially in the context of grants rather than investments. Different funds have different meanings of 'bankability'.[25] However, organisations like the NDC Partnership understand this to mean producing convincing project feasibility assessments and project financial structuring, and accessing international sources of finance through the development of successful project concept notes and proposals.[26]

In a working paper explicitly looking at the idea of 'bankability' in the climate finance sphere, access to data and information was found to be critical in developing project proposals.[27] At various stages throughout the project cycle, EO data can enhance the strength of a proposal for climate finance. Box 2 provides brief resources explaining how individual sections of the application forms to the major funds can benefit from using EO data. Across the various template formats for climate finance applications and proposals, there are commonalities in terms of evidence and justification required.

The 'bankability' of proposals is becoming more relevant as the proportion of grant-based financing reduces.

At a surface level, EO data support applications by generating maps that can pinpoint intervention locations. However, such data are most valuable in informing the decision-making process that leads to identification of those project locations. Satellite remote sensing and EO tools can provide unbiased evidence for selecting an intervention in one community over another, by providing data justifying why one area would benefit more. The literature on digital financial inclusion supports this idea, with positive examples of using EO data to develop models that could predict poverty in Ghana and Uganda, when used in conjunction with phone call detail records and validated by ground-truth surveys.[28]

The 'bankability' of proposals is becoming more relevant as the proportion of grant-based financing reduces amid an increase in volume of blended finance and purely loan-based financing, whether on concessional or commercial terms. The provision of climate finance in grant or grant equivalent form barely changed between 2015 and 2018 (from US$11 billion to US$12.5 billion), yet the provision of concessional, non-concessional and other non-grant finance has increased significantly.[29]

Box 2. EO Data in applications forms of the GEF and GCF

GEF

In applications to the GEF, EO data can enhance the concept development, project preparation, implementation and monitoring and evaluation phases:

- Concept development: In the PIF, EO can be used in the provision of data for mapping the project location and interventions, to assess the baseline and trends, to quantify core indicators, and to review environmental safeguards.
- Project preparation: at the stage of CEO endorsement, EO can improve project location specificity, following discussion with stakeholders, and can help finalise core indicators.
- Implementation and monitoring: in the mid-term review or evaluation process, EO can provide a tool to monitor progress against indicators, visualise status and trends for adaptive management, and can refine project location and interventions.
- Evaluation: during the terminal evaluation, EO can be used to review results against indicators, pinpoint final project locations and intervention areas (if changed), and can analyse project impact (including long-term, intended and unintended consequences).

GCF

The GCF project development cycle involves three key stages: (i) GCF project identification, (ii) concept note development and (iii) funding proposal elaboration.

EO can assist with each stage. For instance, in Section B.1 of the GCF funding proposal form, the adaptation needs must be described and justified. This includes providing data on the target region of the proposed intervention(s), including information on the demographics, economy, topography, etc. The baseline scenario and the methodologies used to derive this information in the feasibility study (detailed at Section H.1, Annex 2 of the application) must also be referenced.

While geospatial information and tools are increasingly more accessible, simple annexes with project location maps are frequently missing from funding proposals in Section H.2, Annex 16, which requires a map(s) indicating the location of the proposed interventions. This might be indicative of poor overall map literacy, but also poses challenges to transparent and independent project monitoring and evaluation. EO can provide support in this area.

EO can also assist with application Sections D.1, impact potential, D.2, scaling up and replication potential, D.4, needs of the recipient (scale and intensity of vulnerability), F, risk assessment and management, and the environmental and social analyses at H.1, Annex 6.

EO can assist in conceptualising country ownership of GCF projects in Section D.5. This can be done by building local capacity of the national designated authority (NDA)/focal point/key staff, the development of decision-making tools and national systems, and by allowing countries to collect, store and manage their own data and information. This can demonstrate that projects are locally driven and aligned with national climate strategies and programmes.

In Section D.3, sustainable development, EO can assist with improving the identification, estimation/quantification, and monitoring of environmental and social co-benefits of a project.

Furthermore, data on specific indicators must be collected during the monitoring, reporting and verification (MRV) of the project to demonstrate that the GCF core, fund-level impacts and outcomes and project performance results have been met. EO is valuable in supporting this process.

Sources: STAP (2019), GCF (2019), GCF IEU (2020a), GCF IEU (2019), GCF IEU (2020b).

When accessing blended or loan-based finance, a proposal must demonstrate both credit worthiness and then additionally secure realistic terms. For instance, interest rates should be appropriately low and risk profiles must be accurate. Information asymmetry can distort these components, resulting in barriers or higher costs to climate action. EO can provide valuable evidence in assessing the risks associated with any given project and financial viability. In presenting the case for credit worthiness, EO data can support instances where, for instance, revenue generation is based on natural processes, like electricity generation from hydropower. EO can provide justification for expected power generation (and thus income) based on rainfall trends, flow rates, etc., across the year. This data can support the financial arrangements section of a proposal to justify the financial exit strategy.

In a similar vein, demonstrating realistic and evidence-based expectations on rates of return, cost-benefit ratios and the general investment potential of an intervention can be supported through satellite remote sensing and EO data, especially in mitigation projects.

Producing bankable proposals, without delays spent adjusting time-consuming iterations of an original submission, is key in progressing projects from the pipeline to implementation. As, for instance, the GCF Board only meets periodically, there is a risk of climate actions being delayed, as poor project proposals that lack convincing supporting information fail to progress at a given board meeting. It is critical to make full use of accurate and relevant data to improve these proposals, so ensuring that quality project proposals are received and approved in a timely manner.

Projects accessing climate finance and EO uptake in the CommonSensing project partner countries

Fiji, Solomon Islands and Vanuatu have accessed funds from a range of climate finance sources, as shown in Table 1. However, aligning with the results of the GEF Independent Evaluation Unit, outlined in Section 3.2 above, uptake of EO data has been heterogenous across projects and countries. For instance, the GCF project in Vanuatu ('*Climate information services for resilient development in Vanuatu*') involves the collection of climate data through EO. The Adaptation Fund projects in Solomon Islands ('*Enhancing resilience of communities in Solomon Islands to the adverse effects of climate change in agriculture and food security*' and '*Enhancing urban resilience to climate change impacts and natural disasters: Honiara*') used, respectively, EO data and satellite sea-level rise data in their supporting background information. Many other proposals mention the need for more utilisation of EO data, but do not explicitly use the tools in supporting the proposal (for instance, Fiji's readiness application to the Carbon Fund of the Forest Carbon Partnership Facility).

There is significant scope to improve and assist climate finance project submissions by using EO and capacity building to strengthen the supporting information for the climate finance requirements. For instance, in Vanuatu, the utilisation of EO data for project design and implementation has been undertaken in an ad hoc manner, with higher utilisation in the energy, forests and land-use, disaster risk reduction, agriculture and water sectors.[30] Should Vanuatu seek to access climate finance to support adaptation in the transport sector, for instance, increased uptake of EO could enable the government to provide data on the impacts of climate change stressors or hazards (heavy rainfall and sea-level rise, and associated coastal and inland flooding, as well as landslides and soil erosion) on road networks and bridges over time. This information can be used to inform policy-makers of transport infrastructure that is most at risk and in need of maintenance, and can provide important baseline data for funding applications to address the infrastructure improvements. Provision of such data could inform the climate rationale, reference conditions, baseline, impact, scaling up and replication potential, needs and

Table 1. Climate funds accessed to February 2020 (data: Climate Funds Update[31])

	Fiji		Solomon Islands		Vanuatu			
Fund Name	Number of projects	Sum of amount of funding approved (USD millions)	Number of projects	Sum of amount of funding approved (USD millions)	Number of projects	Sum of amount of funding approved (USD millions)	Total number of projects	Total sum of amount of funding approved (USD millions)
Adaptation Fund (AF)	1	4.24	2	9.93			3	14.17
Forest Carbon Partnership Facility – Readiness Fund (FCPF–RF)	2	9.60			2	9.93	4	19.53
Global Climate Change Alliance (GCCA)			1	3.14	1	3.59	2	6.73
Global Environment Facility (GEF4)	1	0.98	1	0.95			2	1.93
Global Environment Facility (GEF6)	1	2.12	1	2.64	2	3.49	4	8.25
Green Climate Fund IRM (GCF IRM)	2	32.00	1	86.00	5	19.26	8	137.26
Least Developed Countries Fund (LDCF)			3	14.35	4	16.36	7	30.71
Scaling Up Renewable Energy Program (SREP)			2	13.30	2	13.77	4	27.07
UN-REDD Programme			1	0.55			1	0.55
Grand total	**7**	**48.94**	**12**	**130.86**	**16**	**66.40**	**35**	**246.20**

vulnerability, risk assessment and management, environmental and social analyses, and MRV processes of a funding application.

How is EO data able to buttress decision-making?

Responding to climate and natural disasters

The use of satellite EO, a form of remote sensing,[32] is growing quickly because of its being able to: observe the dynamic changes in the environment and the climate, better assess risk and understand vulnerability, and support evidence-based decision-making when addressing climate change at the global level. For instance, it was invaluable in tracking Tropical Cyclone Harold (Figure 1).

EO provides broad climate and environmental coverage, from micro to macro scales, allowing the monitoring of isolated and inaccessible locations. Furthermore, EO allows the rapid provision of precise and comparable data for improved analysis, whether these events occur in the Pacific, Caribbean or Indian Ocean, for example.

EO provides broad climate and environmental coverage, allowing the monitoring of isolated and inaccessible locations.

EO can also be used in tandem with other technologies like GIS, for instance, for post-disaster situational analysis. It can be used with other forms of remote sensing, environmental modelling, artificial intelligence (AI) and algorithms to establish comprehensive decision support systems to justify why a particular climate action may be needed.

Tools can be developed, using EO data for improved risk and vulnerability assessment, that observe the direction and rate of environmental and climatic change over time, make future projections, and then compare and analyse the data to determine the significance of any potential climate risks.

It is for these reasons that satellite EO data are critical in supporting the management of, and response to, climate and disaster events, especially as they operate continuously and are located at a great distance from any possible damage during crises like cyclones or landslides. In addition, EO data are becoming more and more available and reducing in cost over time, increasing their accessibility.[33]

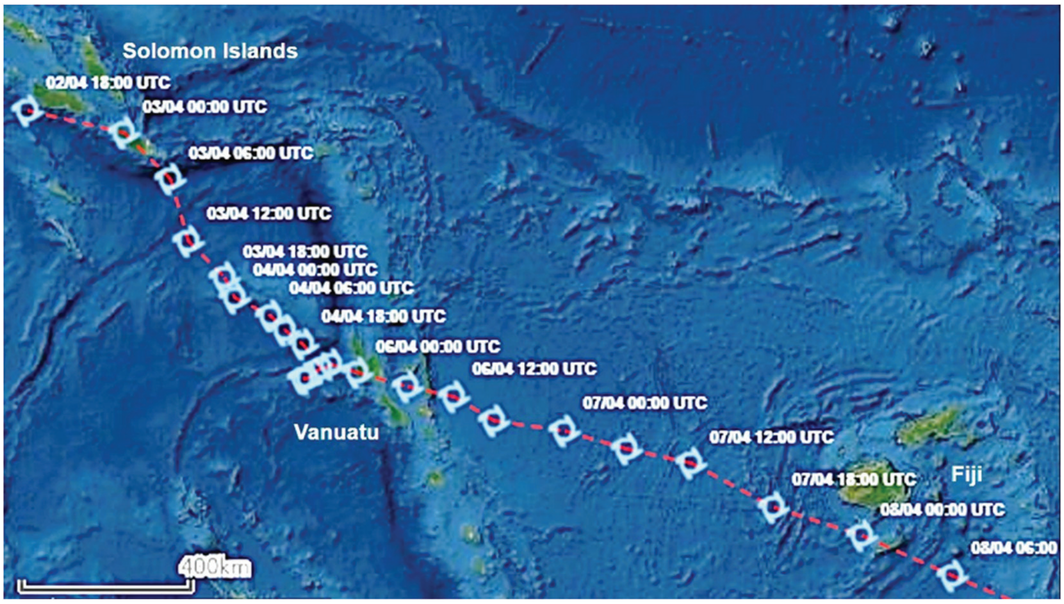
Technically, EO can provide data on significant variables and specifically to nearly half the Essential Climate Variables (ECVs) – as marked in bold in Table 2.

These data can be applied to decision-making across several themes:

- Land surface use, change, climatology, geology, vegetation and ecosystems
- Disaster and risk hazard preparedness, response, and management
- Environmental assessments
- Volcano monitoring
- Public health
- Climate and disaster risk and resiliency communication and investment
- International agreements, migration and security
- Renewable energy potential

Often, needs within these themes are prevalent across national jurisdictions in different ways. EO can support justification for domestic decision-making in identifying specific areas for investment – for example, by providing evidence-based justification for selecting one town over another for an adaptation project. EO can inform these kinds of decisions by providing validation, bias correction and incremental improvement.

Figure 1. Tropical Cyclone Harold – Solomon Islands, Vanuatu and Fiji (2–8 April 2020)



Responding to other shocks, like health disasters
The COVID-19 pandemic is creating high costs worldwide, both in terms of human suffering and economic damage. LDCs and SIDS are especially vulnerable to the economic impact of COVID-19, due to the lack of domestic financial resources, high debt levels and fragile health systems. UN Department of Economic and Social Affairs modelling suggests that growth of per capita income in LDCs and SIDS may need about four to five years to be able to return to the projected path under the baseline scenario without the COVID-19 crisis, based on the slower recovery felt in LDCs and SIDS after the 2008 global financial crisis.[34]

In combatting the economic downturn around the world, leaders are faced with investment decisions that will either entrench our dependence on fossil fuels or put us on a path to achieve the Paris Agreement and the Sustainable Development Goals (SDGs). In the context of investment decisions in developing countries, LDCs and SIDS must be able to access long-term affordable finance to develop and implement green stimulus measures. Hence, the ability to access climate finance effectively is becoming increasingly relevant.

LDCs and SIDS are especially vulnerable to the economic impact of COVID-19, due to the lack of domestic financial resources, high debt levels and fragile health systems.

Vulnerable countries are not able to postpone climate spending while managing the impacts of COVID-19 on other sectors of the economy. Using all the evidence available, including EO data, is one route to preventing investment in maladaptive projects or sectors.

Table 2. Satellite EO makes a major contribution to the ECVs in bold

Domain	Essential Climate Variables
Atmospheric (over land, sea and ice)	Surface: Air temperature, **Wind speed and direction**, Water vapour, Pressure, Precipitation, Surface radiation budget **Upper-air: Temperature, Wind speed and direction, Water vapour, Cloud properties, Earth radiation budget (including solar irradiance)** **Composition: Carbon dioxide, Methane and other long-lived greenhouse gases, Ozone and Aerosol, supported by their precursors**
Oceanic	Surface: **Sea-surface temperature, Sea-surface salinity, Sea level, Sea state, Sea ice**, Surface current, Ocean colour, Carbon dioxide partial pressure, Ocean acidity, Phytoplankton Sub-surface: Temperature, Salinity, Current, Nutrients, Carbon dioxide partial pressure, Ocean acidity, Oxygen, Tracers
Terrestrial	River discharge, Water use, Groundwater, **Lakes, Snow cover, Glaciers and ice caps, Ice sheets**, Permafrost, **Albedo, Land cover (including vegetation type), Fraction of absorbed photosynthetically active radiation (FAPAR), Leaf area index (LAI), Above-ground biomass**, Soil carbon, **Fire disturbance, Soil moisture**

Source: ESA (2015), Satellite Earth Observations in Support of Climate Information Challenges, available at: https://catalogue.unccd.int/577_ESA_CEOS_EOHB_2015_COP21.pdf

Looking forward

Satellite remote sensing and Earth observation technology can be used in many innovative ways to support access to climate finance, beyond the typical uses of the technology in disaster risk reduction and adaptation planning.

As competition increases to access limited climate funds and the global push to 'build back better' from the economic shock of COVID-19 grows, using data to make evidence-based decisions becomes more important than ever. Demonstrating the climate rationale in a proposed intervention, calculating baselines and reference conditions, and measuring the direction and rate of change for key project variables can all be supported by EO data (see Box 3).

The CommonSensing Project seeks to address the problem of converting concepts of climate action into proposals and bankable projects by using EO technology to provide the required evidence base. Nationally Determined Contributions outline ambitious plans to adapt states to the changed climate and mitigate further increases in global warming. Yet, without funding, these national plans will be unachievable for many SIDS and LDCs.

EO technology as a standalone tool cannot fill the evidence-gap in proposals for climate finance. This takes interpretation, correct identification of which variables impact a given project's sustainability and financial viability, as well as the communication skills to translate this technical information into relatable justification for an intervention. There is a pressing need to invest in the skills of technical practitioners based in climate-vulnerable and low-income countries to leverage this technology for the betterment of access to climate finance in the places that need it most.

The cross-over between satellite remote sensing and EO data specialists and those with a keen understanding of the requirements of bankable climate financial proposals is exciting territory, and one which must be expanded to increase the flow of finance to the most climate-vulnerable states on Earth.

Box 3. EO data as a tool for progress during COVID-19

- Value chains have been severely impacted by COVID-19: the observation of airports, maritime transportation, road and industrial sites using EO data and technology contributes to our understanding of the economic impact of the pandemic around the world.
- Travel has been disrupted: EO provides data in geographical areas that are currently hard to reach due to travel restrictions.
- Norms on social gatherings have been disrupted: EO can provide unbiased evidence for project MRV, where independent verification through focus groups is currently unfeasible.
- Food production has been disrupted: under lockdowns, producers may struggle to mobilise labour to plant, tend and harvest crops. EO data supported an evaluation of rice crops in China during the early phase of the pandemic.
- Planning for resilience: COVID-19 has demonstrated how unprepared the world is for disruptive shocks. Preparedness, response and resilience to better manage risks must drive recovery plans, national investments and response measures that are not immediately directed at the health crisis. EO data can provide evidence, justification and support the rationale for sound investment decision-making.

Source for bullet point 4: Guo 2020[35].

Notes

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3 Although satellite imagery has some limitations in that it is not detailed enough to map sub-metre features and cannot penetrate cloud cover, for example, in assessing damage to buildings, it is adequate for flooding, erosion and landslides, along with associated damage to roads or bridges. Where there are clouds obscuring images, images can be fused from multiple images, from cloud-free days and from orbital satellites to provide one clear image.

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