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ON SCIENCE AND TECHNOLOGY FOR DEVELOPMENT (CSTD)**

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Contribution by United Kingdom

to the CSTD 2019-2020 priority theme on “Exploring space technologies for sustainable development and the benefits of international research collaboration in this context

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UK Space Agency

International Partnership Programme





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1. INTRODUCTION

The International Partnership Programme (IPP)¹ is a five year, £152 million programme run by the UK Space Agency. IPP focuses strongly on using the UK space sector's research and innovation strengths to deliver a sustainable economic or societal benefit to emerging and developing economies around the world.

IPP is part of and is funded from the Department for Business, Energy and Industrial Strategy's (BEIS) **Global Challenges Research Fund (GCRF)**: a £1.5 billion fund announced by the UK Government, which supports cutting-edge research and innovation on global issues affecting developing countries. It harnesses the expertise of the UK's world-leading researchers, focusing on:

- funding challenge-led disciplinary and interdisciplinary research;
- strengthening capability for research, innovation and knowledge exchange in the UK and developing countries through partnership with excellent UK research and researchers;
- providing an agile response to emergencies where there is an urgent research or on-the-ground need.

The GCRF forms part of the UK's Official Development Assistance (ODA) commitment, which is monitored by the Organisation for Economic Cooperation and Development (OECD). ODA-funded activity focuses on outcomes that promote long-term sustainable growth of countries on the OECD Development Assistance Committee (DAC) list² and is administered with the promotion of the economic development and welfare of developing countries as its main objective. IPP is fully ODA compliant, being delivered in alignment with UK aid strategy and the United Nations' (UN) Sustainable Development Goals (SDGs).

IPP seeks to use space solutions to make a positive and practical impact on the lives of those living in emerging and developing economies through partnerships with end users in the target countries to increase their capacity to respond to specific challenges.

IPP will also contribute to the continued strength of the UK's space sector, building on the unique strengths that the sector can offer through services and technology to help with aid effort. The projects within IPP span a variety of themes, including reducing deforestation, disaster response, land-use monitoring, reducing maritime problems and renewable energy.

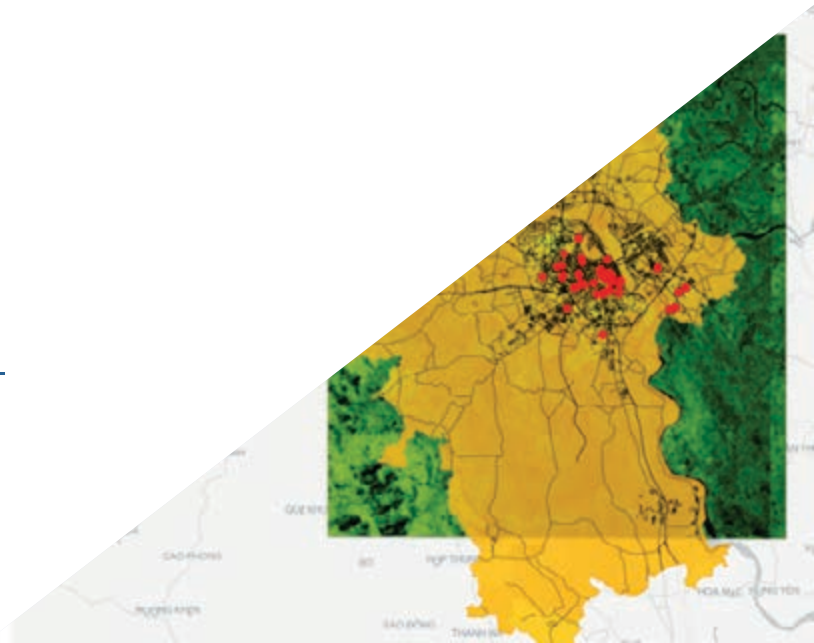
33 projects have been commissioned to date run by a large variety of organisations across industry, academia and non-profit entities. UK and international organisations are involved in the project consortiums.

Contacts

For any information about IPP and the projects within it, please contact the IPP team at:

IPP@ukspaceagency.gov.uk

1 <https://www.gov.uk/government/collections/uk-space-missions-case-studies-and-programmes>
2 <http://www.oecd.org/dac/stats/daclist.htm>



2. IPP GOALS

IPP aims to make a positive, practical impact on the lives of those living in developing countries. Set goals have been agreed by the UK Space Agency Steering Board, the Department for International Development (DFID), and aligned with BEIS GCRF Strategy.

Primary aim of IPP: to deliver a space-enabled ODA-compliant programme that provides a measurable and sustainable economic or societal benefit to its beneficiaries.

Secondary aims

- Develop valued and sustainable partnership arrangements which lead to growth opportunities for the UK space sector;
- Demonstrate the additionality that space-enabled solutions and applications have over terrestrial systems;
- Use the space sector's unique expertise to lead in delivering overseas aid or work with others in their programmes to complement existing ODA efforts.

3. IPP MECHANISM

IPP delivers aid through the provision of grants of 50-100% (depending on the size and type of establishment) for organisations to run projects which meet the aims of the Programme over the course of five years (2016-2021).

This booklet showcases the 33 selected projects from two IPP calls. The majority started in December 2016, providing solutions for local issues in countries across Africa, Asia and Central and South America. Calls are generally comprised of the following elements:

- Scoping study call – run prior to the close of the Open call, this allowed organisations to create partnerships in readiness to submit to the call?
- Open call – applications could be submitted on any theme;
- Tactical call – three tactical calls whereby three countries (Malaysia, Guatemala and South Africa) defined specific problems which had to be addressed by the applicant;
- Strategic call – DFID defined a theme for applicants to address: 'The use of satellite data and technologies in disaster risk management'.

So far 2 IPP calls have been launched, and following an open competition with independent assessors, 33 projects have been awarded grants. A series of calls will be launched during the course of IPP to create a well-rounded programme targeting a range of themes and regions focused on sustainable economic and societal benefit in emerging nations.

Eligible nations must be part of the OECD DAC List of ODA Recipients. The DAC List shows all countries and territories eligible to receive ODA funding. It consists of all low and middle-income countries based on gross national income (GNI) per capita as published by the World Bank, with the exception of Group of Eight (G8) members, European Union (EU) members, and countries with a firm date for entry into the EU. The List also includes all of the Least Developed Countries (LDCs) as defined by the UN. Due to the advanced nature of their space programmes, IPP has excluded China, India and Pakistan from the list of countries available to work with under IPP. We are also unable to fund any work in countries which are involved in active conflict.

Internal IPP Governance

IPP must comply with UK untied aid policy³ such that all procurements must be fully compliant, open to bidders worldwide, and the aid outputs cannot be tied to provision from UK suppliers. UK aid must be

spent in an ODA-eligible country on the approved OECD DAC list and in accordance with the UK International Development Act 2015.

Official Development Assistance (ODA) Compliance and UK Policy

IPP must comply with UK untied aid policy³ such that all procurements must be fully compliant, open to bidders worldwide, and the aid outputs cannot be tied to provision from UK suppliers. UK aid must be spent in an ODA-eligible country on the approved OECD DAC list and in accordance with the UK International Development Act 2015.

Therefore all projects/programmes approved under IPP must be ODA compliant and meet many checks including²:

1. Does it meet OECD ODA directives?
2. Is it consistent with international best practice?
3. Is it a credible use of ODA money?
4. Does it meet the official UK approach and UK Government's aid strategy?
5. Does it contribute to reducing inequality between persons of different gender?

All proposals received into IPP are checked for compliance against these criteria through independent scrutiny, including by IPP's qualified Monitoring and Evaluation and ODA Subject Matter Experts - Caribou Digital.

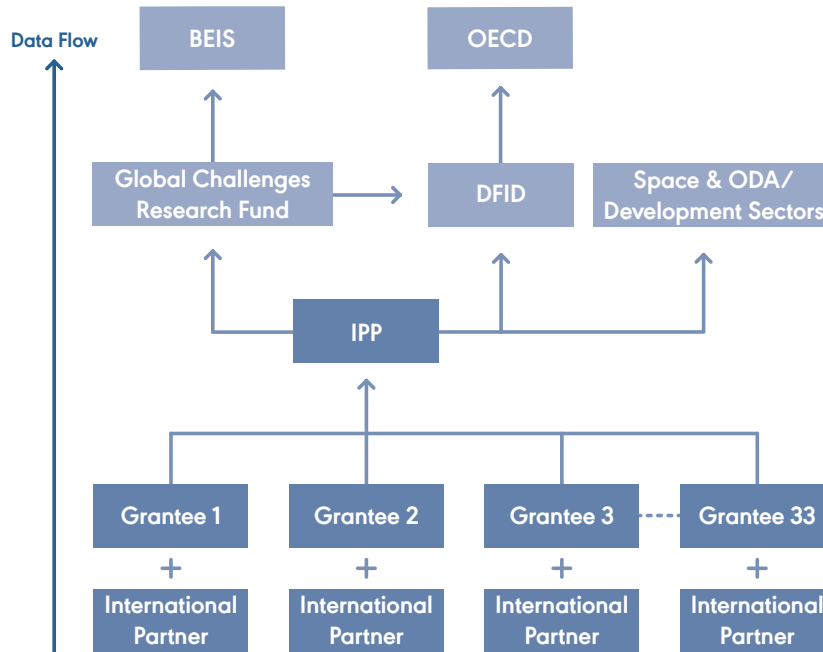
1 UK International Development Act 2015

2 UK ODA assessment guidelines: Jane Casey, DFID Statistics Adviser

4. IPP STAKEHOLDER LANDSCAPE

Stakeholder Map

The following Stakeholder Map shows the key stakeholders and their interrelationships in IPP:



International Partners

International partnerships are a crucial part of the original assessment of projects. These go on to be cemented throughout an IPP projects lifetime through various official agreements such as agreed requirements documents and implementing arrangements. IPP also strives to involve local partners as much as possible by using mechanisms such as joint project boards and maximizing the interaction with UK embassy staff where possible to ensure coherence with other in-country projects and initiatives.

All projects must have a clearly identified international partner from a country on the OECD DAC list in place. This could be with overseas Government organisations, research institutes, local private sector companies, or with international organisations operating in an overseas market, e.g. Non-Government Organisations (NGOs). The background qualification of international partners will be assessed for suitability during the application phase, and all partners must either be, or aligned to, the projects end users.

All participants recognise that strong partnerships are key to a successful project to ensure that the right service is delivered for the right people and will continue after the life of the project, i.e. providing a sustainable economic or societal benefit to the recipient country.

The international partner must be involved in the project and confirm in-kind commitment of funding, people resource, equipment, facilities, etc. to the project from the outset.

5. UK OVERSEAS AID STRATEGY

UK Aid Strategy Strategic Objectives

Advancing economic development in the poorest countries is a hallmark of building Global Britain. It is an essential part of how Great Britain is helping make globalisation work for all and furthering our national interests by playing a leading role on the international stage.

The UK aid strategy is outlined in 'UK aid: tackling global challenges in the national interest' with the strategic objectives of:

1. Strengthening global peace, security and governance
2. Strengthening resilience and response to crisis
3. Promoting global prosperity
4. Tackling extreme poverty and helping the world's most vulnerable
5. Delivering value for money

The IPP portfolio strongly aligns to priorities 2, 3, 4 and 5.

Global Challenges Research Fund (GCRF)

GCRF³ is a £1.5 billion fund which supports cutting-edge research and innovation on global issues affecting developing countries.

GCRF forms part of the UK Government's ODA commitment. It is overseen by BEIS and delivered through 17 delivery partners, which include the UK Research Councils, the UK Academies, and other funding bodies. IPP, run by the UK Space Agency, is part of this fund.

GCRF mobilises the UK's world-leading research and innovation base to address key challenges such as: threats to the sustainability of natural resources; flooding and famine resulting from climate change; environmental degradation; population growth and rapid urbanisation; fragile states, growing inequality, and violence; threats to animal and plant health; and global health challenges, including the development of vaccines and viral threats.

ODA-funded activity focuses on outcomes that promote the long-term sustainable growth of countries on the OECD DAC list. GCRF funding is awarded in a manner that fits with official ODA guidelines.

GCRF and its delivery partners work in union with other UK ODA funds. We specifically work alongside the Newton Fund⁴, ensuring join up where possible. The Newton Fund works in specific countries on the DAC list and covers 3 broad categories of activity:

- **people:** improving science and innovation expertise (known as 'capacity building'), student and researcher fellowships, mobility schemes and joint centres;
- **research:** research collaborations on development topics;
- **translation:** innovation partnerships and challenge funds to develop innovative solutions on development topics.

3 <https://www.gov.uk/government/publications/global-challenges-research-fund/global-challenges-research-fund-gcrf-how-the-fund-works>

4 <https://www.gov.uk/government/publications/newton-fund-building-science-and-innovation-capacity-in-developing-countries/newton-fund-building-science-and-innovation-capacity-in-developing-countries>

United Nations' (UN) Sustainable Development Goals (SDGs)

The UN SDGs were adopted by world leaders in 2015. Over the next 15 years, with these new Goals that universally apply to all, countries will mobilise efforts to end all forms of poverty, fight inequalities and tackle climate change.

The 17 SDGs are as follows:



All projects were assessed on their applicability to the SDGs to ensure alignment of IPP with the SDGs.
Of these 17 goals, IPP has so far aligned with 12.

The UN SDG framework has been used because:

- It is a globally-agreed set of development priorities across 193 Member States, global civil society, and the development community;
- It is globally-agreed language that IPP international partners will recognise;
- It is stable over a very long time period to 2030;
- The UN is investing significant resources in establishing teams, processes and systems to track progress towards achieving the goals;
- All Member States are required to report to the UN their domestic contribution to achieving the UN SDGs.

Throughout this brochure, the SDGs which match the project are displayed in the bottom left corner.

6. MEASURING IMPACTS

As the GCRF funding for IPP is classified as ODA, a rigorous **Monitoring & Evaluation (M&E) function is key to measure and communicate the benefit and impact of IPP on developing countries.**

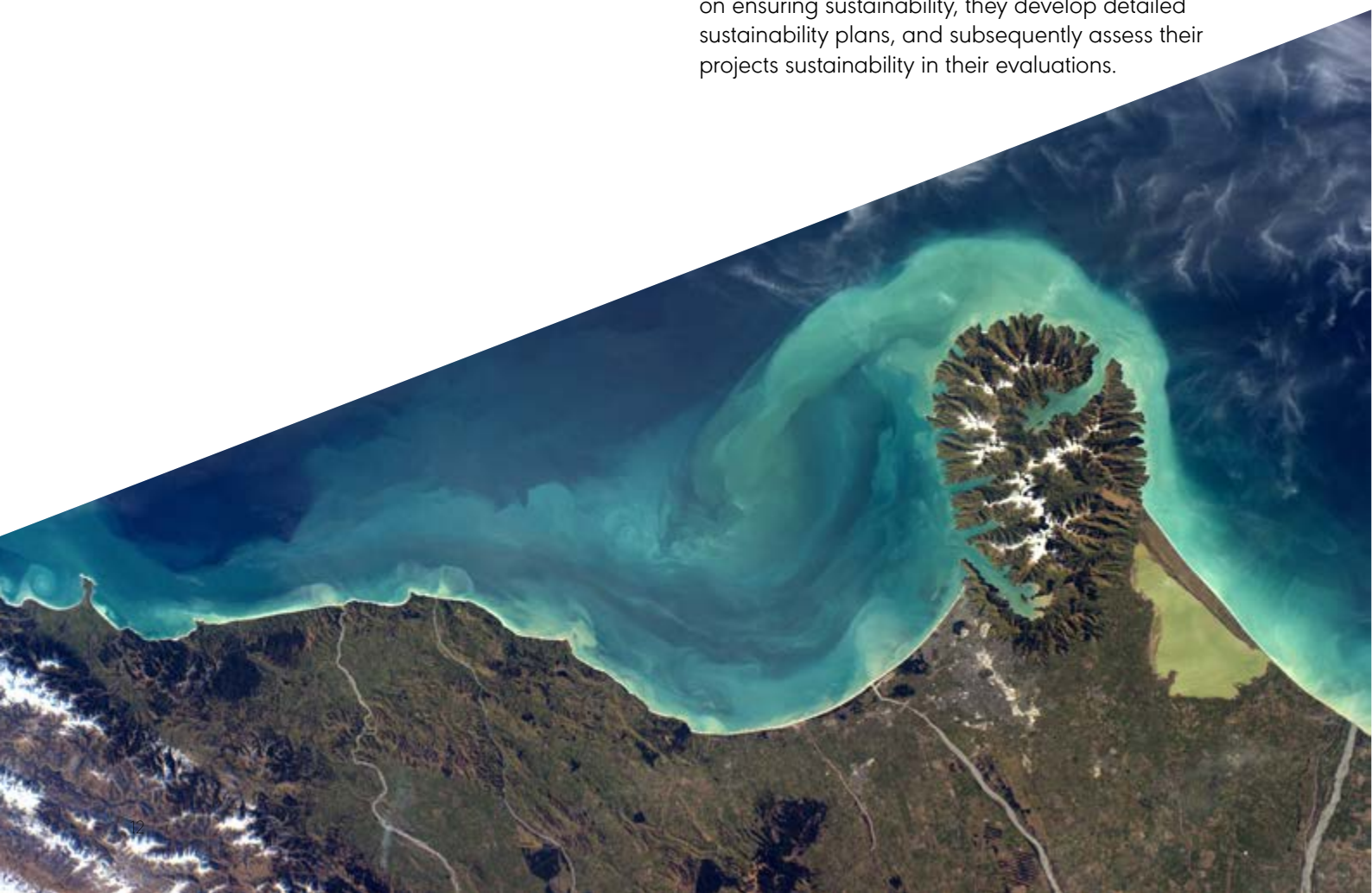
Rigorous M&E activities are executed within the IPP programme and also within every individual project by their respective consortiums. The IPP M&E methodology follows HM Treasury's 'The Magenta Book: Guidance for Evaluation', which provides guidance on what to consider when designing an evaluation for UK Government-funded programmes and policies.

M&E support and ongoing ODA compliance is carried out by Caribou Digital. Caribou Digital is an M&E specialist with extensive knowledge on use of ODA within the space sector, and is part of the IPP team. This expertise provides the necessary independent advice to the UK Space Agency to ensure that all proposals recommended as suitable for funding meet OECD standards for ODA eligibility and M&E compliance, and continue to comply throughout the life of each project.

The ODA and M&E assessment criteria used are:

- Clearly able to show it meets ODA definitions and criteria
- Impact on gender equality
- Need for service and impact on the country and quality of the Theory of Change
- Demonstrable and measurable benefits and impacts and quality of the Logical Framework
- Applicability to UN Sustainable Development Goals
- Quality M&E Strategy including appropriate methodology and resourcing
- Quality of the Knowledge Sharing plan
- Sustainability of the project outcomes and impacts beyond the period of UKSA funding

A key part of the M&E function is supporting the projects to ensure long-term financial sustainability. All grantees have included work packages focused on ensuring sustainability, they develop detailed sustainability plans, and subsequently assess their projects sustainability in their evaluations.

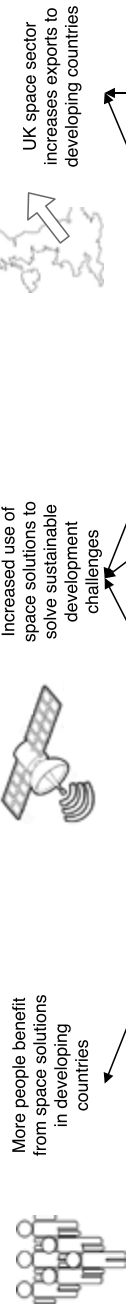


The International Partnerships Programme Theory of Change

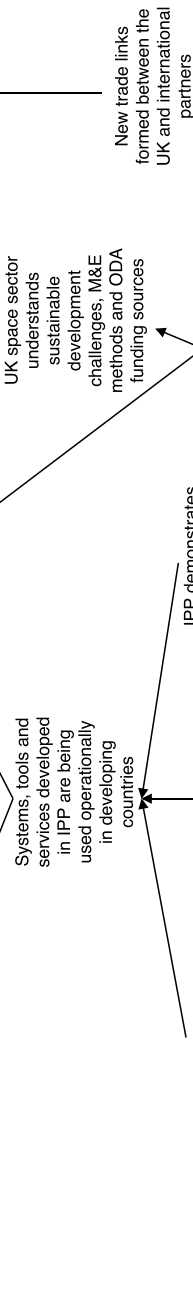
A sustainable, positive impact on the UN Sustainable Development Goals by 2021



Impacts



Outcomes



Outputs



Activities



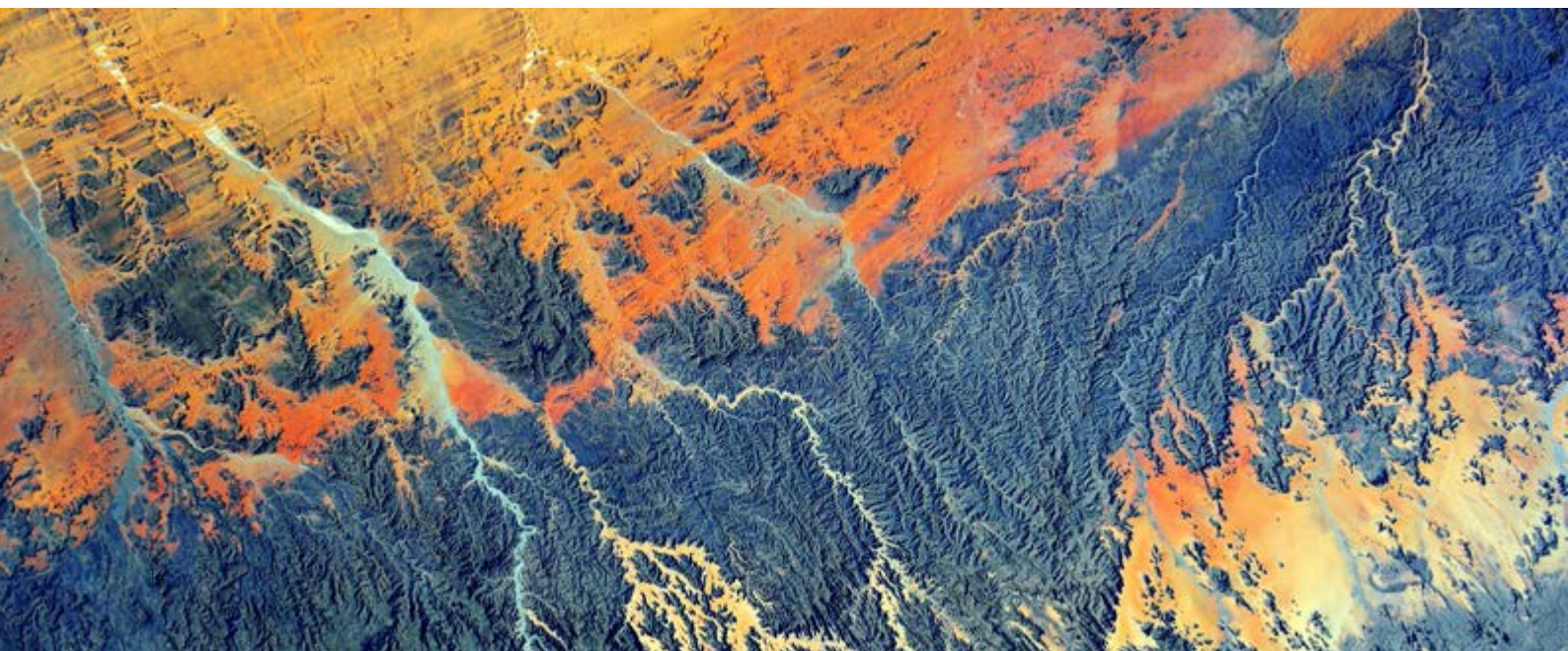
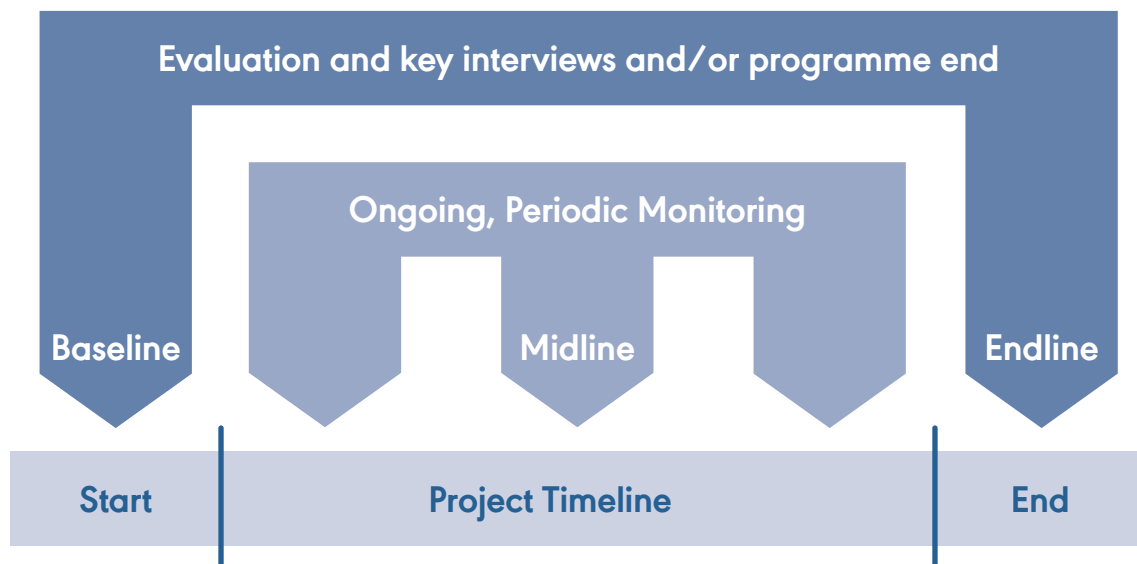
Monitoring and Evaluation

To ensure measurable benefit is made in the target country, the grantee is responsible for monitoring and evaluating the effects of their projects and must build this activity into their work packages.

Monitoring occurs regularly throughout the IPP lifecycle, whilst evaluations occur at the beginning (baseline), middle (midline) and end (endline) of the lifecycle. M&E will take place within each project and for the programme as a whole.

Evaluation of the programme will focus on three key areas:

- Process Evaluation – How was IPP and the individual projects delivered?
- Impact Evaluation – What difference did IPP and the individual projects make?
- Economic Evaluation – Did the outcomes and impacts of IPP and the individual projects justify the costs?



Knowledge Sharing

Knowledge sharing will promote good practice across the wider sector, maximising the impact from ODA funds.

All grantees have included a work package/ activities focused on knowledge sharing whereby they will use their own communication channels to share the results, findings and learning from their project to the wider space and ODA/development sector. Knowledge sharing activities typically include: case studies, research reports, academic papers, workshops, conference presentations, infographics, and web and social media promotion.

There are multiple routes to good practice, including:

- Knowledge sharing driving replication across other organisations within the space and ODA/development sectors;
- Grantees offering the same solution to new customers and in new markets;
- Grantees developing new technologies and products from learning from the IPP grant;
- Organisational capacity building for use of space expertise in developing countries.

Amplification:
Industry, academia
and donors drive
amplification of impact



Replication:
Encourage replication
across industry



Co-investment:
Add up to £1 match
partner funding



Seeding & Testing:
For every £1 invested
by UKSA IPP

7. IPP PROJECTS

The IPP projects are being run in partnership with developing countries across the globe, working with in-country experts to ensure alignment with their needs. The following breakdown shows which project is located in which region:

Africa

Advanced Coffee Crop Optimisation for Rural Development (ACCORD)	Earth-i	Rwanda, Kenya
Coastal Risk Information Service (C-RISE)	Satellite Oceanographic Consultants (SatOC)	Madagascar, Mozambique, South Africa
Deforestation prevention	Vivid Economics	Côte d'Ivoire
Drought and Flood Mitigation Service (DFMS)	Rheatech	Uganda
FireSat	Clyde Space	South Africa, Kenya, Namibia
Flood and Drought resilience	Airbus Defence and Space	Ethiopia, Kenya
Forests 2020	Ecometrica	Kenya, Ghana (also Brazil, Mexico, Indonesia, Colombia)
iKnowledge	Avanti Communications	Tanzania
Modelling Exposure through Earth Observation Routines (METEOR)	British Geological Survey	Nepal, Tanzania
Property database for Dakar City	Airbus Defence and Space	Senegal
Pest Risk Information Service (PRISE)	CAB International	Kenya, Zambia, Ghana
Renewable Energy Space Analytics Tool (RE-SAT)	Institute for Environmental Analytics (IEA)	Seychelles, Mauritius (also Montserrat, St. Lucia)



SatCom for Nigerian Health Services	Inmarsat	Nigeria
Satellite Enablement for Disaster Risk Reduction in Kenya (SatDRR Kenya)	Avanti Communications	Kenya
South Africa Safety Initiative for Small vessels' Operational Take-up (OASIS-TU)	exactEarth	Madagascar, South Africa



Asia

Earth and Sea Observation (EASOS)	Satellite Applications Catapult	Malaysia
Forests 2020	Ecometrica	Indonesia, (also Brazil, Mexico, Colombia, Ghana, Kenya)
Improved Situational Awareness in Fisheries (ISAIF)	Janus TCD	Philippines
Dengue fever Early Warning System (DEWS)	HR Wallingford	Vietnam
Modelling Exposure Through Earth Observation Routines (METEOR)	British Geological Survey	Nepal, Tanzania
SatComs for natural disasters	Inmarsat	Philippines
Peatland Assessment in SE Asia by Satellite (PASSES)	CGI IT UK Ltd	Indonesia, Malaysia
Recovery and Protection in Disaster (RAPID)	Astrosat	Vietnam
SIBELIUs: Improved resilience for Mongolian herding communities	eOsphere Limited	Mongolia
Satellites for sustainable fishing	Inmarsat	Indonesia

Small Island Developing States

CommonSensing	United Nations Institute for Training and Research (UNITAR)	Fiji, Solomon Islands, Vanuatu
Renewable Energy Space Analytics Tool (RE-SAT)	Institute for Environmental Analytics (IEA)	Seychelles, Mauritius, Montserrat, St. Lucia

Central America

Crop Observation, Management and Production Analysis Services System (COMPASS)	Rezatec	Mexico
Forest 2020	Ecometrica	Mexico (also Colombia, Brazil, Indonesia, Ghana, Kenya)
Forestry Management And Protection (FMAP) system	Astrosat	Guatemala

South America

EcoProMis	Rothamsted Research	Colombia
EO4Cultivar	Environment Systems	Peru, Colombia
Land-use interventions	Vivid Economics	Peru
Space-based dam monitoring	HR Wallingford	Peru
Satellite Enabled Maritime Domain Awareness (SEMDAC)	Satellite Applications Catapult	Chile
Space Enabled Monitoring of Illegal Gold Mining	Satellite Applications Catapult	Colombia

Preserving and expanding forests to the benefit of rural communities in Côte d'Ivoire

Project lead
Vivid Economics Ltd

Target country(s)
Côte d'Ivoire

Project consortium
Remote Sensing Applications Consultants Ltd (RSAC), Impactum

International partners

Ministry of Planning and Development

(Cote d'Ivoire): The Ministry of Planning and Development is responsible for the implementation and monitoring of the Government's policy on development planning and programming. The Ministry has its own projects but also serves as a liaison body between the various ministerial departments involved in development policy. A Memorandum of Understanding has been signed for the project.

Society for Forest Development (SODEFOR):

Office in charge of managing commercial forest plantations.

The Office of Parks and Reserves (OIPR):

Office in charge of managing the national parks and natural reserves.

REDD Permanent Executive Secretariat (SEP-REDD):

Office in charge of all the REDD activities in Côte d'Ivoire.



Deforestation prevention with land-use monitoring and valuation in Côte d'Ivoire

Project summary

The project aims to alleviate two key development problems in Côte d'Ivoire: rural poverty, which afflicts more than half of the rural population; and deforestation for economic development, which has led to the loss of 80% of the country's natural forests. It will contribute to efforts to reduce poverty and protect forests by developing tools that help policy-makers preserve and expand forests to the greatest benefits of rural communities, and to integrate relatively unproductive smallholders into more valuable global supply chains. Three tools will be created:

- Land use inventory that classifies and differentiates physical surface cover types.
- Natural capital valuation framework that informs national reforestation and forest protection strategies, and supports the extension of sustainable supply chains. This will integrate the land-use inventory with other economic information on the value of production and eco-systems services to map the value of land under different uses, recorded in a natural capital accounting balance sheet.
- Forest disturbance early warning system to tighten enforcement of land-use rules.

These will drive two key outcomes: improved monitoring and enforcement efforts that prevent forest loss and prioritise afforestation; and better targeted support to local economic development and sustainable supply chains through Payment for Ecosystem Services (PES) schemes.

All three tools represent substantial improvements upon what is currently available, but the real benefit of the project lies in their combination and close integration into policy and regulatory activity. The tools will cover an area in the south west of Côte d'Ivoire covered by the Emissions Reduction Programme (ERP) initiative. The ERP region was chosen as it contains much of the country's remaining natural forest and is the focus of the

development of sustainable supply chains and PES schemes in the country.

Satellite solution

The land use inventory will be developed using newly available data from the Copernicus Sentinel satellites that offer higher resolution and revisit frequency than Landsat, which has been used for mapping in the past, supplemented by even higher-resolution information from SPOT satellites.

The forest disturbance early warning system will make use of a technique developed by RSAC for the rapid detection of forest disturbances using radar time series from satellites.

Project impact

Contribute to achieving 20% of national forest cover by 2030:

- Zero forest degradation in existing protected areas in the region by 2020, and all of Côte d'Ivoire's remaining 3–4 million hectares of forest by 2023.
- 60,000 hectares of natural forest regeneration and 60,000 hectares of gazetted forests annually by 2020, expanding to a combined total of 180,000 hectares annually by 2023.

Improve supply chain sustainability:

- 100% deforestation-free production for cocoa, rubber, and palm oil in targeted region by 2020, and nationally by 2023.
- creation of new markets for ecosystem services (for example through PES mechanisms) that enable the commercialisation of preservation and restoration activities.
- broad delinking of agricultural production and deforestation through greater productivity per hectare of production.

Decreasing illegal forestry activities in Guatemala

Project lead
Astrosat Ltd

Target country(s)
Guatemala

Project consortium
Earth Observation Ltd, Deimos,
Telespazio Vega

International partners

National Forestry Institute (INAB): a public entity responsible for the agriculture public sector in the forestry domain. An Implementing Agreement was signed in February 2017 between the UK Space Agency and INAB.

National Council of Protected Areas (CONAP): a government agency responsible for the conservation, rehabilitation, and protection of Guatemala's natural resources and its biodiversity.

Guatemala Environmental Police Force (DIPRONA): the division of the National Civil Police that oversees the prevention of environmental crimes.

Ministry of Agriculture (MAGA): in charge of creating the policies to ensure growth and development in the areas of agriculture, livestock and hydrology resources.

Public Ministry: in charge of attending to direct victims and collateral victims of crime.

ARCAS Guatemala: a non-profit Guatemalan NGO formed in 1989 by a group of Guatemalan citizens who became concerned as they saw their precious natural heritage – especially their wildlife – rapidly disappearing.



Forestry Management And Protection (FMAP) system for tackling illegal logging

Project summary

The illegal exploitation of the forest environment is a real concern to the Guatemalan government. Illegal removal and transit of valuable trees, change of land use, and other such illegal and unregulated activities are having huge impacts – both environmentally and socio-economically – throughout the country. The Guatemalan government has made efforts to tackle this problem by embracing digital technologies, improving its processes and by pooling information between all stakeholder agencies, but the problem is persistent due to the forests of Guatemala being too big to be effectively monitored and managed using conventional, terrestrial, techniques.

The FMAP project aims, through the use of space technologies and satellite-derived data, to solve this issue by improving the capabilities of the agencies responsible for forestry governance. It will provide a centralised platform, utilising satellite remote sensing and Global Navigation Satellite Systems (GNSS) technologies that will enable intelligence-led governance and interventions which have the largest impacts on tackling this problem.

The project's objectives are to:

- Reduce the incidence of deforestation in Guatemala by creating a space-technology driven forestry management tool.
- Reduce land crime through increased land-use change detection with a higher temporal resolution to provide intelligence for DIPRONA enforcement officers. DIPRONA will be able to arrest or prosecute parties guilty of illegal activities due to the increased knowledge and situational awareness provided by FMAP.

- Upgrade and improve existing traceability systems through the addition of satellite-derived data and GNSS mobile applications to support better forestry management and enforce prosecutions. FMAP will reduce costs of measurement, reporting, verification and prosecutions through the concessions system.
- Increase the efficiency, impact and scalability of the forestry incentive programmes by reducing the costs of monitoring and land-use verification in the current systems. This will utilise GNSS mobile applications and space-based data to improve INAB's ability to track land management, increasing capacity and supporting efforts to reduce deforestation.

Satellite solution

With over 3.7 million hectares of forests in Guatemala, EO tools offer the most effective way of monitoring activities which would not be possible from the ground. The FMAP system utilises EO data from various sources to provide periodic data acquisition of land use and land change. The TreeTAG system uses GNSS technology to greatly increase the efficiency of locating trees, reducing the time it takes loggers to locate trees to harvest.

Project impact

- Increased capacity of Guatemalan Government Agencies to conserve Guatemala's forestry environment.
- Reduce the rate of deforestation in the Mayan Biosphere Reserve.
- Increase the total area of ecosystems under sustainable management.
- Increase the number of detections of illegal forestry activities.

Protecting and restoring forests across the world



Project lead
Ecometrica

Target country(s)
Brazil, Colombia, Mexico, Ghana, Kenya, Indonesia

Project consortium
University of Edinburgh (NCEO), University of Leicester (NCEO), Carbomap

Forests 2020 – Improving forest monitoring systems through better application of satellite data

International partners

Indonesia

Bogor Agricultural University (IPB): one of the leading universities in Indonesia that focuses on agriculture and forestry.

PT Hatfield Indonesia: a pioneer in the field of environmental services in Indonesia.

World Resources Institute: works with leaders in business, government and civil society to address climate change, forest restoration, forest governance, and access to information.

Daemeter: a leading independent consulting firm promoting sustainable development through responsible and equitable management of natural resources.

Brazil

National Institute of Space Research (INPE): linked to the Ministry of Science, Technology and Innovation in Brazil, aims to provide science and technology in space and the terrestrial environments.

Institute of Environmental Research of the Amazon (IPAM): non-profit research institute, focusing on the ecological limits of land use/cover and climate change to Amazon forest ecosystems.

KeyAssociados: helps clients integrate Environmental, Social and Corporate Governance (ESG) management into their business strategies, products and services in Brazil. It is a well connected organisation in Brazil, working closely with private, public and civil society organisations.

Mexico

El Colegio de la Frontera Sur (ECOSUR): leading the study of forest resources using geographic information systems and remote sensing tools.

Pronatura Sur: Mexican NGO recognised for its contribution to the conservation of areas of high ecological value.

Ambio: Mexican NGO promoting rural development from the participation of communities.

State Forestry Development Programme (FIPRODEFO): autonomous government institution, which serves as the technical and operational body on issues of relevance in the state of Jalisco's forests.

Colombia

Meteorology and Environmental Studies of Colombia (IDEAM): part of the Colombian Ministry of the Environment and Sustainable Development.

University of Andes (UniAndes): leading the Colombian Data Cube project for more than a year at IDEAM.

Ghana

Kwame Nkrumah University of Science and Technology (KNUST): promotes the proper management of sustainable utilisation of forests through teaching, research and dissemination of information.

Resource Management Support Centre (RMSC) of the Forestry Commission Ghana: is the technical wing of the Forestry Commission of Ghana.

Kenya

Kenya Forest Service: mandated to enhance development, conservation and management of Kenya's forest resources base.

Project summary

Forests provide vital services including livelihoods, water and habitats for millions of species, and are essential for combating climate change. Despite frameworks to help developing countries protect and restore their forest resources, inadequate monitoring systems remain a barrier to effective implementation. Earth Observation (EO) is widely acknowledged as the only effective way to monitor forests at regional and national levels; however accuracy, frequency, speed, and delivery of EO data products remain a challenge.

Forests 2020 is a 40-month project from a consortium of UK experts and international partners led by Ecometrica, which aims to address these technical barriers to improve forest monitoring systems in six developing countries to support REDD⁺¹, FLEGT² and other aspects of forest governance and biodiversity conservation.

The project will focus on three areas of forest monitoring systems:

- Improved detection of forest changes, particularly in challenging ecosystems and land use situations.
- Improved mapping of risks and priority areas, particularly ways in which local organisations and district or state-level forest authorities can input and interact with the forest maps and forest change detection.
- Digital infrastructure for managing and distributing EO-derived and related information to ensure robustness, consistency, continuity and availability of data products to end-users.

Satellite solution

This project is using EO imagery from satellites to improve forest monitoring across six partner countries. It works with leading experts from the National Centre for Earth Observation (NCEO) in leading universities in the UK and with international partners to test new forestry monitoring methods in the following areas:

- detecting change in forests (deforestation and degradation) from both optical and radar imagery from satellites like the European Space Agency's (ESA) Sentinel-1 and Sentinel-2.
- incorporating these observations into risk models for mapping risk of deforestation and forest fires, and mapping suitable areas for restoration.
- improving digital infrastructure to manage and disseminate forest-related data.

These new methods will enable our partner countries to use more frequent, better quality data, quicker, improving the national forest monitoring systems.

Project impact

Protection and restoration of up to 300 million hectares of tropical forests by improving national forest monitoring systems in six partner countries through better applications of satellite data.

1 Reducing emissions from deforestation and forest degradation, forest carbon stock conservation, the sustainable management of forests, and the enhancement of forest carbon stocks in developing countries are activities commonly referred to as REDD⁺.

2 FLEGT stands for Forest Law Enforcement, Governance and Trade. The EU's FLEGT Action Plan was established in 2003. It aims to reduce illegal logging by strengthening sustainable and legal forest management, improving governance and promoting trade in legally produced timber.



Reducing poverty and net deforestation of primary forest in Peru



Project lead
Vivid Economics Ltd

Target country(s)
Peru

Project consortium
Remote Sensing Applications Consultants Ltd (RSAC).

International partners

Ministry of Agriculture and Irrigation: the governing body of the National System of Forestry and Wildlife.

Ministry of Environment: responsible for ensuring the environmental sustainability of the country and preserving, protecting, restoring and ensuring ecosystems and natural resources.

Amazon Interregional Council: seeks to contribute to public policies, programmes and projects of common interest between the five Amazon regions, with special emphasis on initiatives relating to natural resources and the environment.

Alternative Mechanisms for Development: seeks to promote sustainable development through strategic partnerships between government, the private sector, local people and local and international organisations.

Remote mapping and socio-economic valuation tools to support planning and implementation in land-use interventions in Peru

Project summary

The project addresses two of Peru's most acute development challenges: reducing the rural population in poverty (currently 3 million), and preventing deforestation from its current rate of 250,000 hectares per year. The two challenges are closely linked in a number of ways. Unregulated land use is a major cause of both, facilitating encroachment on forests by the subsistence farmers who are responsible for 75% of losses, while also stemming flows of investment that could improve their productivity and incomes. However, solutions to the problems often require balancing trade-offs between them: for example, new infrastructure that can improve livelihoods might also accelerate deforestation.

The overall objective of this project is to contribute to efforts to reduce poverty and protect forests by developing satellite-based data tools that help policy-makers to understand and address these linkages.

The tools developed by the project, and the engagement with government in the adoption and application of the tools, will assist decision-making in four key areas of policy activity: land use ('zoning') regulation; infrastructure provision; land permitting; and sustainable production and irrigation.

The project tools will support these aims by providing three layers of information:

- **Land use inventory** that classifies and differentiates physical surface cover types.
- **Economic-ecosystem valuation tool** that improves zoning rules and regulations, prioritises planned investments, and focuses enforcement and incentive mechanisms to improve effectiveness.

This will integrate the land-use inventory with other economic information to map the value of land under different uses and the risk land faces of unauthorised exploitation.

- **Plot-level mapping and technical specifications** to improve titling, enforcement of land-use rules, supporting programmes and technical assistance. This will map areas identified as high-risk in greater detail using Unmanned Aerial Vehicle (UAV) surveys, providing information on forest thinning needed to enforce restrictions on deforestation and support certification of sustainable production.

Satellite solution

The land use inventory will be developed using newly-available data from the Copernicus Sentinel satellite that offers higher resolution and revisit frequency than Landsat, which has been used for mapping in the past, supplemented by even higher-resolution information from the RapidEYE and SPOT satellites.

Project impact

- Reduce net deforestation of primary forest;
- Improve ecosystem quality by reducing degradation and improving connectivity of forest areas.
- Increase agricultural productivity of targeted small producers without increasing agricultural lands.
- Increase the proportion of producers with secure land ownership rights.
- Increase the proportion of farms who are sustainably certified, with resulting impact on the income they are able to generate.

Using satellite imagery for improved, cost effective peatland monitoring in SE Asia

Project lead
CGI IT UK LTD

Target country(s)
Indonesia, Malaysia

Project consortium
Geomatic Ventures Ltd, Centre for Ecology and Hydrology, University of Leicester, University of Nottingham, Liverpool John Moores University, IPE TripleLine.

International partners

Peatland Restoration Agency (BRG): a non-structural institution responsible for coordinating and accelerating the recovery of Indonesian Peatlands.

Asia Pacific Resources International (APRIL): a private pulp and paper company who manages Indonesian forest land.

World Resources Institute Indonesia (WRI): research organisation dedicated to socio-economic development.

Geospatial Agency (Badan Informasi Geospasial, BIG): the agency in Indonesia responsible for ensuring access to reliable geospatial information and encouraging the use of that information in governance and community life.

IPB: a top university in Indonesia that focuses on tropical agriculture and forestry, with a long history of research on peatland.

Global Environment Centre (GEC): a non-profit organisation registered in Malaysia working with state government planning agencies and private sector organisations to enhance sustainability of peatland management.



Peatland Assessment in SE Asia by Satellite (PASSES)

Project summary

Tropical forest fires affect over 20 million people in SE Asia. The inhalation of smoke generated from the fires leads to significant deteriorations in public health and is associated with premature mortalities. Fires also contribute substantially to global CO₂ emissions and other widespread negative environmental impacts. Many fires occur over drained peatland areas.

Climate change and existing land use trends such as the draining and clearing of forests for palm oil, pulp and paper plantations contribute to the reduced hydrology of the peatland, causing a significant fire risk. Without intervention, peat fire frequency and impact are expected to increase. The only long-term intervention is to retain the natural hydrology of intact peat swamp forests and raise water levels in disturbed areas. However, the costs of restoring and maintaining peat condition across huge peatland areas (~250K km² in SE Asia) are enormous. The planning and prioritisation of such activities, as well as monitoring intervention effectiveness, is therefore vital. Furthermore, better observations of peat condition also enable improved understanding of the delivery of peatland ecosystem services.

Satellite observations of peat condition can play a hugely valuable role in peatland monitoring, but currently are under-exploited. The PASSES project will use the latest satellite measurement techniques to develop a comprehensive peatland monitoring service. PASSES will also demonstrate that wide area, routine, comprehensive monitoring of peatland can now also be cost effective, through exploitation of freely available, continuous observations from Sentinel satellites and exploitation of emerging industrial hosted processing capabilities.

Satellite solution

Tropical peatlands are highly dynamic systems, which occur across large, often remote and inaccessible areas, and are highly vulnerable to land-use change. Understanding, managing and protecting these systems requires monitoring capabilities which are frequent, reliable and wide area. Satellite remote sensing provides the only cost effective option.

Key to realising a comprehensive and cost-effective satellite-enabled monitoring solution are the Sentinel satellites (S-1, S-2 and S-3 are relevant). Dense time series from S-1 provide the input for a novel InSAR technique developed by the University of Nottingham that is core to PASSES and enables observation of vertical displacement of peatland; a key indicator of condition since drained and degraded peat subsides whilst recovering peat (in response to re-wetting interventions) swells and rises. The SAR-enabled vertical displacement observations will be complemented with other SAR and optical-derived measurements. These will include observations of vegetation, hydrology and fire regime. Together these observations will enable a comprehensive characterisation of peat condition, which, if observed over time, can inform an enhanced understanding of condition change.

Project impact

- Improved management and condition of peatland in SE Asia.
- Demonstrable evidence of improvement in key peat condition metrics in regions where PASSES has been included in decision-making, compared to those where it has not.

Improving the livelihoods and incomes of smallholder coffee farmers by delivering accessible advice for farmers to improve their crop quality and yield

Project Lead (company)

EARTH-i

Target country(s)

Rwanda and Kenya

Project consortium

WeatherSafe, Oxford Policy Management, San Francisco Bay Coffee Ltd

International partners

Coffee Management Services Ltd: a leading agri-business service provider offering a wide range of services in the coffee sector in Kenya and wider East Africa region.

Rwanda Kinini Coffee Ltd: a coffee cooperative whose farming and trade activities, supported by the ACCORD service has resulted in the creation of Schools, Nurseries and other social services that are shared among a growing community of farmers, their families and the wider community.



Advanced Coffee Crop Optimisation for Rural Development (ACCORD)

Project summary

Coffee is a global commodity with growing demand globally, with revenues directly benefitting farmers in developing countries. Despite this, in Kenya and Rwanda 67% and 80% of people respectively live in poverty, including most smallholder coffee farmers. Easy access to information on management practices and weather and nutrient monitoring can drastically increase earning potential by improving coffee quality and quantity.

Coffee farmers must make critical decisions, such as whether and when to apply fertilisers, pesticides or fungicides at potentially short notice. Correct early advice makes a huge difference to the effectiveness of these decisions and enables improvements in the yields of high quality coffee which increase incomes.

ACCORD provides farmers with access to timely, geo-targeted advice through a simple mobile application. The unique and proven method employed by the consortium combines satellite imagery with ground observations, and a custom high-resolution localised weather forecast model, in a cost-effective manner. All the data is integrated and analysed to create clear advice through the mobile-enabled platform to agronomists, cooperatives and farmers. Access to this highest quality advice is not available at scale through any other method.

Satellite solution

A regular feed of EO data can be used to monitor each plantation, and provide information on crop health. The varying field sizes lend themselves to EO imagery to capture detail, and the crop cycles require regular data acquisition during the growing season, something not possible with UAVs.

Very high-resolution weather data, created using a custom weather model and accurate topography data will help to plan around the complex terrain and varying weather conditions between neighbouring coffee plantations.

A unique combination of space-based technologies will be used throughout the project. These will include:

- Optical satellite imagery that will unlock information on crop health and detect the early warning signs of pests, diseases and nutritional defects.
- High-resolution, customised weather forecasts will be created by taking into consideration local topography derived from high-resolution satellite data, as well as by integrating public sources.
- Detailed mapping of coffee plots and nearby infrastructure will provide reference data on size and facilities for smallholders, producers and exporters.

Project impact

The ACCORD project will lead to Kenya and Rwanda being empowered to grow more speciality coffee through more efficient and timely crop management.

The primary benefits that we expect the ACCORD project to realise will be:

- Improved yield – measured through annual data from coffee washing stations and validated with a sample of interviewed farmers. We forecast that yield will double over a three-year period.
- Improved coffee quality - measured through annual data from independent cupping tests and corroborated through increased price/kg of coffee achieved by the farmers for their crop. Our target is 25% improvement in cupping scores.
- Improved farmer income – validated with a sample of interviewed farmers. Our target is doubling of smallholder coffee income by year 3 of the project.

Secondary impacts of these improvements include the increased taxation revenues to Kenyan and Rwandan governments from the increased production.

Improving productivity in wheat and sugar cane for smallholder farmers in Mexico



Project lead
Rezatec

Target country(s)
Mexico

Project consortium Booker Tate Ltd,
The University of Nottingham

International partners

International Wheat and Maize Improvement Centre (CIMMYT): prioritises research relevant to ensuring global food security and a decrease in poverty.

College of Postgraduates (COLPOS): Mexican public institution of higher education with international recognition that prepares students for a globally competitive world in which knowledge is the most important asset.

Mexican Crop Observation, Management and Production Analysis Services System (COMPASS)

Project summary

The project consortium is working with CIMMYT and COLPOS in Mexico to help smallholder farmers growing sugar cane and wheat to improve crop management. Mexican farmers need to improve crop productivity and stabilise their incomes to facilitate rural community economic development. The tool developed by this project will help farmers to identify factors that cause the yield gap between crop potential and actual field performance.

The project will provide six customer-specific decision support tools to help growers, including smallholders, improve their technical, environmental and financial performance. The project will also provide commercial information support, following the trials that are underway, to advisory services, agribusiness, farmer cooperatives, crop insurers and governments to create a long-term income stream to support Rezatec's provision of these services.

Satellite solution

This project is using EO data from ESA's Sentinel constellation and commercial satellites in combination with in-field measurements and computer modelling. The overall challenge for the crops is to transform both traditional extensive as well as modern intensive systems into sustainable systems producing more crop output with better use of resources. This requires better management of the interacting parameters controlling yield.

There are about 30 site-specific parameters grouped by soil, management, inputs and environment that can determine the production efficiency of wheat and sugar cane crops, e.g. soil type, harvest date, disease control and temperature. The theoretical effect of these parameters on production is understood. However, there are no practical, evidence-based, management decision tools that support smallholders and larger growers by targeting production efficiency per specific field.

Project impact

- Improved productivity, particularly for smallholder farmers, in two of Mexico's major crops, wheat and sugar cane.
- Improved resource-use efficiency and hence lower emissions (for example, of fertiliser nitrogen and greenhouse gases).
- Improved market function as farmers, traders, government and other stakeholders will have improved information on likely crop yields, allowing much better planning of crop marketing, which helps to stabilise incomes.
- Through improving technical and market performance, the project will assist rural economic development in Mexico, improve food security (wheat) and generate increased export earnings (sugar cane).

Improving rice and palm oil production while reducing environmental impact, enhancing biodiversity and improving the social and economic conditions of smallholders



Project Lead

Rothamsted Research

Target country(s)

Colombia

Project consortium

Agricompas, Pixalytics, Elastacloud

International Partners

CIAT: CIAT lead in the area of database management for phenomics and gas emission.

Cenipalma: Colombian Palm Oil Research Centre, focuses on solving pest and disease problems and technical crop aspects.

Fedearroz: the Colombian National Federation of Oil Palm Growers

Solidaridad: international NGO facilitating the development of socially responsible, ecologically sound and profitable supply chains, working through nine regional expertise centres in around 50 countries.

Ecological Productivity Management Information System (EcoProMis) for oil palm and rice in Colombia

Project summary

Rothamsted will be working with Agricompas, Pixalytics and Elastacloud in the UK and CIAT, Cenipalma, Fedearroz and Solidaridad in Colombia to develop an Ecological Production Management Information System (EcoProMis). This system will provide crop production knowledge to growers and decision support to key stakeholders in oil palm and rice value chains. This new knowledge will optimise production, efficiency and resilience to deliver solutions that enhance the environmental footprint of smallholder farmers and improve social and economic wellbeing.

Colombian smallholder rice and oil palm farmers need to improve productivity and stabilise incomes to allow them to compete globally and improve their livelihoods, whilst responding to climate change and realising a positive environmental impact.

The project will engage with smallholder farmers through outreach programmes to collect data and provide training, so that their skills and understanding on how crop management affects productivity, income and sustainable ecosystems is developed. Smartphones are used to communicate data and knowledge directly from and to farmers in the field.

EcoProMis will create a Management Information System that combines crop production knowledge per field with economical, environmental and social information to provide commercial decision support to a wide range of stakeholders across the value chains such as input providers, (food) processors, insurance firms and governments to create a sustainable platform for knowledge to partners and decision support to crop stakeholders.

The project will create ongoing impact through a public-private partnership of farmers, research institutes and Agricompas that builds comprehensive sets of crop and ecosystem data and models to provide near real-time knowledge that is made freely available for the partners to improve the environmental, technical and financial efficiency of their processes.

Satellite solution

The project uses satellite Earth Observation combined with crop production data to research the impact of crop and ecosystem management on biodiversity and greenhouse gas (GHG) emissions. Sentinels -1 and -2 will be used for SAR and optical imaging to provide information on crop health and biomass.

Project impact

- Land managers adopt sustainable land management processes, which mitigate greenhouse gas emissions, adapt to climate change and maintain ecosystems.
- Farmer incomes increase in oil palm and rice growing areas by \$30m per annum by adopting more efficient production and through premium prices by reporting on sustainability.

Contributing to sustainable food production systems and resilient agricultural practices

Project lead
Environment Systems Ltd

Target country(s)
Peru and Colombia

Project consortium
Barfoots, Geoseren, Joint Nature Conservation Committee (JNCC), EDINA, a centre for digital expertise at the University of Edinburgh, The Open University and Aberystwyth University; Wavehill is engaged as a subcontractor

International partners

Peru

ITP CITE Agroindustrial Ica and CITE Chavimochic: regional government organisations that improve the competitiveness of local agricultural businesses through research, development, and technological transfer.

Danper and DM Agrícola: established exporters of fruit and fresh asparagus from Peru.

Colombia

Geits: a consultancy and services company based in Bogota. They develop EO solutions for agriculture and bring experience of monitoring potato crops.

Campo Vivo: a Joint Venture between McCain Foods and Yunus Social Business with the mission to improve the livelihoods of local farmers and their families living in low socioeconomic communities in rural Colombia.

ASBAMA: The Banana Association of Magdalena and La Guajira



EO4cultivar

Project summary

By developing the ability to easily disseminate and incorporate EO data for use in decision making in agricultural supply chains, EO4cultivar will have real impacts on supporting crop production, improving yield for key growers, and managing risk in agricultural supply chains in Peru and Colombia. EO can provide timely field-scale crop observations at regional scales into the high-value South American agricultural market. Better information from EO data services and capacity building will strengthen business operations by increasing the range of evidence and management tools available to grower organisations, leading to improved economic outcomes. Improving crop management will improve sustainable farming practices.

There are sources of free and commercial satellite imagery, but currently no capability to process the data necessary to deliver national agricultural data services in South America. EO4cultivar will work with commercial and government stakeholders in Peru and Colombia to deliver information frequently and rapidly within the growing season via trusted channels.

Cloud-based processing and storage infrastructure will be developed to deliver services, such as a time series of imagery at the field level to monitor crop performance and target management, as well as for crop identification to support biosecurity, resource planning and market intelligence needs. Case studies will help organisations make best use of data products and services, alongside existing local knowledge, to inform activities that support sustainable livelihood development.

Three PhDs will be hosted at UK universities to enable knowledge transfer and capacity building to the target countries.

Satellite solution

Both radar and optical data from ESA's Sentinel satellites will be used to provide up-to-date information on crop status (e.g. health, growth stage or vigour) throughout the growing season. Commercial growers and farmer advisory services will use secure data services to access 'analysis-ready' maps, images and data that they can use in the office or on portable devices. This might be for individual fields, farms or regional areas and will reflect the demand for timely information to improve crop production, support sustainable farming practices and manage risk.

Project impact

- To make a positive contribution towards sustainable food production systems and the implementation of resilient agricultural practices.
- To increase productivity and manage risk in agricultural supply chains.
- To support inclusive and sustainable economic growth in target agricultural sectors.
- To help maintain ecosystems and ensure smallholder farmers benefit from project activities.

Increasing food security by reducing crop losses from pest outbreaks

Project lead
CAB International

Target country(s)
Ghana, Zambia, Kenya

Project consortium
Assimila; Kings College London; Centre for Environmental Data Analysis

International partners

Plant Protection & Regulatory Services Directorate (PPRSD, Ghana): Ghana's national institution with the mandate and capacity to organise, regulate, implement and coordinate the plant protection services.

Kenya Agricultural & Livestock Research Organisation (KALRO): Government institute with the mandate to promote, streamline, coordinate and regulate all aspects of research in agriculture and livestock development.

Kenya Ministry of Agriculture, Livestock and Fisheries (MOALF): Ministry responsible for supporting agricultural research, and developing regulation and information on the agriculture sector.

Zambia Agriculture Research Institute (ZARI): The Zambian government department responsible for agricultural research.



Pest Risk Information Service (PRISE)

Project summary

An estimated 40% of the world's crops are lost to pests (including insects, mites and plant pathogens), impacting on the ability of smallholder farmers to feed their families and also affecting international trade and food supply chains. By alerting them to the potential presence of pests, this project aims to enable farmers to manage outbreaks more effectively using Integrated Pest Management methods. These techniques have many advantages, such as the reduction of the use of inappropriate pesticides that lead to human and environmental benefits as well as reducing spend on unnecessary spraying.

Innovation is essential to provide new solutions to the problem of pest outbreaks, and this project combines novel EO technology, satellite positioning, plant health modelling, and on-the-ground real-time observations to deliver a science-based Pest Risk Information Service (PRISE) for sub-Saharan Africa. The solution is also developed through:

- Risk forecasts that will be integrated into existing plant health systems.
- Crowd-sourcing observations that will be established to strengthen and validate the system.
- Using existing networks in current projects to trigger appropriate action to deliver alerts, advice and inputs to farmers.
- A service that will be developed and sustained by building in-country technical capacity and interrelated business plans that engage the private sector (e.g. agro-dealers and insurance companies).
- Involving the Ministries in the countries to encourage them to develop policies to strengthen crop protection by the demonstration that an effective pest forecasting service can be scaled to regional and national levels.

This early-warning system unites the capability of the UK partners to: collect and combine disparate datasets; manipulate data using computational and modelling expertise; and leverage well-established international development networks. Commitment from Ministries of Agriculture in Zambia, Ghana and Kenya ensures their engagement and active participation. In-country data collected from the field will be fed into the system, to be used in line with the computational results. Appropriate communication methods will deliver risk messages and mitigation measures to users as well as collect their feedback.

PRISE will improve the livelihoods of smallholder and larger scale farmers by reducing crop losses caused by pests across three sub-Saharan African countries and to be active in six countries by the end of the project.

Satellite solution

PRISE will use a range of satellite data at different scales to provide pest risk models with environmental information they need, of which surface temperature is the most important variable. Effective modelling on a country-wide scale requires data that accurately represents local weather conditions for agricultural zones. To meet these needs, data from satellite technology such as Meteosat SEVIRI, Terra/Aqua MODIS and Sentinel-3 SLSTR will be fused to produce a seamless service which will be used to drive pest risk models.

Project impact

By enabling farmers to reduce crop losses from pest outbreaks in the target countries, the project will:

- Contribute to reduction in hunger
- Increase food security
- Increase farmer incomes.

Fostering climate resilience for small island nations using remote sensing

Project lead (company)
United Nations Institute for Training and Research (UNITAR) – Operational Satellite Applications Programme (UNOSAT)

Target country(s)
Fiji, the Solomon Islands and Vanuatu

Project consortium:
Satellite Applications Catapult, UK Met Office, Devex, University of Portsmouth, Commonwealth Secretariat, Radiant. Earth, Sensoronic.

International Partners

Fiji Ministry of Lands & Mineral Resources: committed to the effective and efficient administration, development and management of all state land initiatives including facilitation of the country's mineral sector and ground water resources.

Solomon Islands - Ministry Of Environment, Climate Change, Disaster Management & Meteorology: responsible for sustainable environmental management, climate change adaptation, mitigation, disaster risk management and meteorological services.

Vanuatu Ministry of Climate Change Adaptation, Meteorology, Geo-hazards, Environment & Energy: responsible for the development of identification, implementation, management and evaluation of energy projects, monitoring and facilitating energy activities as well as providing awareness and training activities.

Vanuatu National Disaster Management Office (NDMO): the government's agency responsible for coordination of preparation and responses to emergencies and disaster.



CommonSensing

Project summary

Small island nations located in the Pacific are exposed to the damaging effects of climate change. Such changes in the climate system have direct effects on the livelihoods, the economy, overall development and the very existence of many small island nations. Urgent action towards increasing the capacity for climate resilience is therefore required.

The overall aim of CommonSensing is to use satellite remote sensing for applications that support three Commonwealth countries: Fiji, the Solomon Islands and Vanuatu to improve national resilience towards climate change. The project's main output is to provide the evidence and data needed for these island states to be able to apply to the Commonwealth Climate Finance Access hub with a much higher degree of success than present. This will allow these island states to obtain the funding they need to protect critical infrastructure and build resilience into their economy to combat the growing effect of climate change. A key aspect of the project is its integration with the Commonwealth's Climate Finance Access Hub to use the established channels for increasing success in accessing climate funds.

CommonSensing will deliver impact in two main areas:

- In terms of Earth Observation (EO) derived services, CommonSensing will use EO data to provide partners with access to vital information regarding disaster and climate risks to inform planning, food security needs and impact on the environment. This information will be readily available to users through easily accessible services.
- In terms of sustainability and capacity development, partners aim to contribute to national and regional technical capabilities to inform policy and secure funding for climate change resilience programmes beyond the three-year project. In addition, CommonSensing consortium partners are committed to supporting the long-term sustainability of the information services they develop with the three country partners.

Satellite solution

EO data used in the project includes satellite images from optical satellites, including Sentinel-2, SPOT and

Landsat, radar imagery from Sentinel-1 and elevation data from PALSAR.

In order to produce solutions with greater efficiency and at reduced cost, partners will work on the systematic and regular provision of data at an analysis ready state, termed ARD, in particular thanks to the use of Data Cube (DC) technology. This project offers a significant opportunity to bring together key stakeholders in ARD and DC technology to advance its maturity, whilst also addressing key UN-SDG challenges.

Project impact

The partnership will enable the three Governments and their ministries and agencies responsible for climate resilience to harness the full potential of satellite Earth Observation data to support their policy development and programmes.

Economic benefits

- Improved multi-sectoral mitigation/adaptation investments based on climate funds in target countries.
- Reduced economic losses from natural disasters.
- Reduced costs in accessing innovative software solutions and EO data.

Social benefits

- Reduced human losses from natural disasters.
- Better education and awareness of Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) for building resilient communities.

Environmental benefits

- Better information to support the management of natural resources and improved ecosystem conservation through the use of EO-based solutions.
- Better information to support the planning and implementation of climate change adaptation initiatives to address the adverse impacts of climate change on sustainable development.

Reducing the impacts of flood and drought in Uganda



Project lead
Rheatech

Target country(s)
Uganda

Project consortium
Environment Systems, Pixalytics, Databasix, AA International, AgriTechTalk International, HR Wallingford, UK Met Office, Mercy Corps, Oxford Policy Management.

International partners

Ministry of Water and Environment, Uganda: responsible for water resource planning and regulation.

Kakira Sugar Company: drive the requirements to meet the farming needs of the company and its community of contributing farms in terms of improved meteorological and climate information.

Drought and Flood Mitigation Service (DFMS)

Project summary

The DFMS platform will be delivered to the Ugandan government. It will provide the people of Uganda with practical information that will help them respond to the effects of climate change. The aim is to use satellite and ground-based data, combined with drought and flood models, to help people respond to effects on agriculture. Information will be distributed by national, local government and commercial operators to farmers and relevant parties such as NGOs. Through better forecasts, local people can improve their lives and better protect key assets such as livestock and crops.

The focus is on improved climate modelling and its impact on agriculture enabled by the development of an innovative, open-source, integrated platform that is designed to assimilate diverse data sources, ranging from satellite and meteorological data, to engaging networks of smallholder farmers in real-time data collection and analysis by using apps and associated tool kits.

Benefits include:

- A better ability to forecast and mitigate droughts and floods on a local actionable scale.
- NGOs will be able to target resources saving time, money and lives.
- Local stakeholders can improve their lives and better protect key assets such as livestock and crops.

Once proven, the system will be adaptable globally for any similar area. The project will also generate evidence of use, enabling further sustainable development through user buy-in from government, the independent sector and commercialisation of information dissemination.

Satellite solution

The drought and flood forecasting service will rely on information collected from the Copernicus fleet of satellites, as well as other freely-available sources:

- ESA's Sentinel-1 satellite gives 24-hour, all-weather radar images for monitoring water bodies and floods as well as monitoring agriculture.
- Sentinel-2's high-resolution multi-spectral imaging will be used alongside Sentinel-1 to support the generation of highly localised agriculture information.
- Sentinel-3 will be used to monitor water height alongside other freely-available sources. Key derived information includes: precipitation, downward solar radiation, land surface temperature and emissivity, soil moisture and soil reflectivity, and vegetation indices.

This satellite data will be fused with ground-based measurements from meteorological and hydrological sources as well as very localised information collected by farming communities about the current state of crops and livestock. This will provide a validation of the satellite data, allowing accurate forecasts across the region.

Project impact

- Reduction in the risk of flood and drought impacts on the livelihoods of pilot communities.
- Increase in crop yields for commercial farmers.
- Increase in farmers in pilot communities using the weather prediction to adjust their farming and livestock activities.

Reducing illegal logging, marine pollution and monitoring flood events in Malaysia



Project lead
Satellite Applications Catapult

Target country(s)
Malaysia

Project consortium
Janus TCD, Astrosat, Geocento Ambiental, Plymouth Marine Laboratory, AutoNaut, Riskaware, Telespazio Vega, Earth Observation Inc., Leicester University, Sterling Geo, Oxford University, eOsphere

International partners

National Defence University of Malaysia (NDUM): premier defence university for leadership and professional development, knowledge dissemination and application of defence science and technology, as well as policy research. For this project, NDUM has co-ordinated a group of key policy makers, end users, budget authorities and key decision makers into a single stakeholder forum.



Earth And Sea Observation System (EASOS)

Project summary

Environmental challenges present a serious social and economic threat to the Malaysian people, and their government has consequently identified these three major challenges as critically important priorities to be addressed: marine pollution, illegal logging and flood risk.

EASOS will deliver an integrated user-centred dashboard to 23 government agencies in Malaysia by trialling and evaluating solutions with the respective Malaysian government departments.

Specifically EASOS will deliver information and analysis on three environmental challenges:

- Reduce the degradation to the mangrove coastline in Malaysia by reducing marine pollution in the Malacca Straits and supporting prosecution of offenders: Information from the dashboard will enable authorities to identify and locate discharges, forecast the pollution dispersal and identify the vessels that are likely to be responsible.
- Reduce the social and environmental impact of illegal logging and increase the economic benefit from legal logging: By monitoring deforestation and accurately detecting illegal logging activities, it will provide information on the location and extent of activities to direct intervention and provide potential evidence for prosecution. Furthermore, the electronic tagging of legally harvested logs will allow traceability through the entire supply chain. The system will provide the Malaysian government with alerts, allowing them to intervene quickly.
- Reduce the economic and social cost of flood events: Alerts will be generated that will enable response teams to activate evacuation plans and short-term flood defences. By implementing the EASOS system, the Malaysian government will have access to improved advanced warning times, better information about impacted areas, and predictions of improving or deteriorating conditions.

Satellite solution

One of the major strengths of satellite-based EO is the ability to monitor large areas of the surface quickly and cheaply vs implementing a ground-based system. This is particularly true in remote areas and/or in areas which are large enough that no technical solution meaningfully exists. The project will utilise ESA's Sentinel 1 and 2 EO data for this purpose and provide access to high-resolution imagery through a data hub. Satellite aspects include the acquisition and analysis of Synthetic Aperture Radar (SAR) data for oil spill detection, Automatic Identification System (AIS) data for attributing spills to particular vessels, GNSS for location of tree tagging, and autonomous surface vessels and satellite communications for remote communication of ground sensors.

Project impact

- Reduction of the harmful environmental and social impacts associated with illegal logging, marine pollution and flood events in Malaysia.
- Increased economic benefits and savings to Malaysia from identifying illegal logging, marine pollution and flood events.

Reducing the economic impact of flood and drought in Ethiopia and Kenya



Project lead
Airbus Defence and Space

Target country(s)
Ethiopia and Kenya

Project consortium
Vivid Economics Ltd, Oxford University,
Sayers and Partners LLP (SPL), GeoSAS Ltd

International partners

Ethiopian Development Research Institute (EDRI):
the leading think tank and economic research
house in Ethiopia.

Building Africa (BUA), Kenya: not-for-profit NGO
promoting and developing integrated and
coordinated strategies for the building of Africa.

Earth Observation-enabled decision support for flood and drought resilience in Ethiopia and Kenya

Project summary

Both Ethiopia and Kenya are flood and drought prone with significant mortality and economic losses attributed to these events in each country. This project focuses on building resilience to these events to both lessen risk and support economic resilience.

In Ethiopia it will focus on building an improved understanding of flood and drought hazards and risks to help build social and economic resilience to water-related hazards. In Kenya it will focus on the effectiveness of EO data for the micro-insurance market and Government Institutions; an important tool for farmers who currently have little or no access to insurance. This will be supported by the development of a flexible dashboard with tailored information to assist decision making related to flood and drought at the following geographical levels:

- Ethiopia: at basin level (working with the Ministry of Finance and Economic Cooperation).
- Kenya: at local level (working with women farmer intermediaries and micro-insurance actors) and at county and sub-county level (working with the National Drought Management Authority).

Information will include:

- Ethiopia: Assessments of risks and socio-economic damages due to flood and drought to the Climate Resilience Green Economy secretariat. Information will be in the form of reports, maps, statistics, probability of occurrence, model outputs, etc. This will allow authorities to conduct better planning for both food shortages and adaption measures for climate change.
- Kenya: historical and actual information on drought and floods occurrences. In particular, the actual information will inform a continuous monitoring process on the crop status

on a 10-day and 20 metre basis.

This will allow the following scenarios:

- micro-insurances to take decisions on the farmer compensation.
- governmental authorities to better manage flood disasters and periods of food shortages, and address governmental subsidies.
- farmer communities to take decisions on selling/buying pastoral goods on the market during the crisis periods.

Capacity building in both Ethiopia and Kenya will take place with the end users of the dashboard.

Satellite solution

This project will initially use EO data from ESA's Sentinel 2 satellite and the UK-built DMC2 satellite, with additional data from the KAZSTSAT satellite once it is launched. In addition space-derived weather, temperature, climate, and elevation data will be heavily used in the project. The data will be used in a drought indexing mechanism and the outcomes, which are expected to include present weather conditions and forecasts, will be presented to the users via an online dashboard.

Project impact

- Reduction in the effect on the population of flood and drought by reducing the variance in crop output, reducing the numbers of livestock lost, supporting crop productivity and reducing damage to infrastructure
- Reduction in the population at risk due to floods and drought and an alleviation of the economic impact of flood and drought.

Using nanosatellite technology to improve fire detection rates and build human capacity in Africa

Project Lead
Clyde Space

Project consortium
University of Strathclyde;
Satellite Applications Catapult

International partners

Cape Peninsula University of Technology (CPUT): a leading South African university, and the African lead on project, responsible for coordination of international stakeholders, lead on the development of ZACube-2 CubeSat platform, provision of students for MSc and PhD at Strathclyde, host missions lab facility.

The Council for Scientific and Industrial Research (CSIR): CSIR is one of South Africa's public research institutions mandated to support improvement to the quality of life of the people of the Republic through directed multidisciplinary research and technological innovation.

Namibia University of Science and Technology: education in applied research, innovation and service.

Technical University of Kenya: Provide technological education and training and to contribute towards the advancement of society through research and innovation.

South African National Space Agency (SANSA): deriving greater value from space science and technology for the benefit of South African society.



FireSat – a space segment to complement the advanced fire information system

Project summary

This FireSat pilot programme will demonstrate the ability of nanosatellite technology to deliver enhanced fire detection data to be implemented into the existing Advanced Fire Information System (AFIS) developed by the CSIR, as well as provide capacity building for future skills, technology and applications development.

Africa is often referred to as the 'Fire Continent' and accounts for 70% of the total global wildfires and over 50% of the total area burned in the last two decades¹. These fire incidents are causing significant social, economic and environmental losses. Lloyd's insurance market estimates that the impact to the South African economy alone is approximately £225 million due to wild fires over the past 5-7 years.

The FireSat demonstrator mission will see delivery of a space-based EO nanosatellite platform to detect wildfires in Africa. The FireSat payload is developed by the CSIR and provides a method of detecting smaller fires (90 m²) more effectively. This data will be implemented into AFIS, which is the data-delivery mechanism for this project. Products such as monthly burned area estimates as well as daily and weekly fire danger forecasts are produced and disseminated to fire management teams who can respond quickly to extinguish the fire.

In addition, the project also consists of an extensive capacity building element whereby a custom MSc course will be developed and nanosatellite Missions Labs will be commissioned. The MSc will be developed by the University of Strathclyde in the area of small satellite technology and applications to meet the needs of students in South Africa, Kenya and Namibia.

This will provide students with the skills to ensure future technology development and commercialisation of technology on return to their home countries, in turn enabling considerable economic and societal growth. This aim will be furthered by the commissioned Missions Lab infrastructure to allow future nanosatellite technology, missions and applications to be developed in South Africa, Kenya and Namibia.

Satellite solution

The AFIS ingests data from NASA and ESA satellites to detect possible hotspots on the ground. Geostationary platforms provide wide-scale observations on the order of 1-4 km every 15 minutes, while polar orbiting satellites can detect smaller fires, of the order of 30-200 m, every few days. The addition of data from the FireSat nanosatellite will offer complimentary capability to existing datasets to improve the observation of 90 m² fire events.

Project impact

- Reduce the damage to infrastructure caused by wild fires.
- Reduce the injuries and loss of life caused by wild fires.
- Develop skills in-country to provide continued development of resilient infrastructure and the use of space technology to generate solutions to in-country challenges.

¹ NASA website: https://www.nasa.gov/mission_pages/fires/main/modis-10.html

Earth Observation for robust exposure data and better-informed Disaster Risk Management

Project lead
British Geological Survey (Natural Environment Research Council)

Target country(s)
Nepal and Tanzania

Project consortium
Humanitarian OpenStreetMap Team, ImageCat Inc., Oxford Policy Management, Fathom, Global Earthquake Model (GEM)

International partners

Disaster Management Department, Prime Minister's Office, Tanzania, will engage Tanzanian DRM expertise, validate exposure datasets, calibrate models and build links between METEOR and local policy makers.

National Society for Earthquake Technology (NSET), Nepal will lead on the improvement of the local capacity to use EO data, assess disaster risk, support development of DRM policies (with support from the Housing Ministry and the Disaster Management Department) and coordinate the production of educational and training material to promote the use of the products of this project throughout Nepal and Tanzania.



Modelling Exposure Through Earth Observation Routines (METEOR)

Project summary

The escalating impacts of natural hazards are caused mostly by increasing exposure of populations and assets. It is estimated that the world will see the construction of 1 billion new dwellings by 2050 and this growth may lead to rapid increase in risk.

A major challenge when making Disaster Risk Management (DRM) decisions in ODA countries is poor understanding of the distribution and character of exposure to these hazards. METEOR takes a step-change in the application of Earth Observation exposure data to allow quantitative assessment of exposure, leading to better-informed DRM decisions.

Working with partners in Nepal and Tanzania we will test and validate the process of producing and utilising exposure data. Co-designing results internationally will help improve response to hazards and promote welfare and economic development. Country-wide, openly-available exposure data will be rolled out for the 48 least developed ODA countries.

The project objectives are to:

- Increase the resilience of Nepal and Tanzania to natural hazards through integration of robust and open building exposure data derived from satellite data.
- Improve capacity for stakeholders in the use of exposure data in Disaster Risk Reduction (DRR) and DRM in Nepal and Tanzania.
- Deliver robust and open protocols for exposure development.
- Deliver open-source, national-scale building exposure data for all 48 counties on the DAC list of least developed ODA recipients
- Directly contribute to UN Sustainable Development Goals and Sendai Framework for DRR by improving resilience and adaptive capacity to hazards and substantially increasing the availability of and access to disaster risk information.

Satellite solution

METEOR will improve upon existing Earth Observation methods for characterising the built environment. Working in unison with our partners and end users, we will develop and share protocols to produce robust exposure information and promote its use to strengthen the resilience and adaptive capacity of Nepal and Tanzania (in particular) to natural disasters. The application of EO data allows us to utilise the same robust process across borders, which is a critical issue when using traditional census data that tend to have different classification systems and protocols. EO tools offer the most effective way to produce consistent and open exposure in data poor countries, many of which have rapidly-expanding urban areas.

Project impact

- To substantially increase the availability of (and access to) more robust disaster risk information for all 48 counties on the DAC list of least developed ODA recipients.
- To strengthen the resilience and adaptive capacity to natural disasters of Nepal and Tanzania.
- A network of stakeholders better placed to act as leaders of DRM/DRR in their geographic region.

Providing the Philippines with satellite communications to reduce the impact of natural disasters



Project lead
Inmarsat

Target country(s)
Philippines

Project consortium
Satellite Applications Catapult,
Télécoms Sans Frontières (TSF),
TD International, Devex

International partners

Department of Social Welfare & Development (DSWD), Philippines: chairs the national disaster response.

SatComs for natural disasters

Project summary

The Philippines suffers over 20 cyclones annually, as well as frequent volcanic eruptions and earthquakes. It is highly experienced at responding to rapid onset disasters, but a key lesson from Typhoon Yolanda in 2013 was the ineffective deployment of crisis communications.

This project transforms disaster responses by pre-positioning in-situ powerful but easily deployable equipment, including Inmarsat's new Global Xpress (GX) satellite equipment. Rapid deployment at the disaster area will provide the national coordinating authority with the infrastructure to run national and local disaster response communications, at scale.

The project will:

- Provide the Philippine government with the capability to rapidly restore communications and increase command and control of recovery operations within 24 hours of occurrence of a disaster.
- Provide a measurable improvement to sub-national and local capacities in terms of standard operating procedures on communications systems among provincial, city and municipal disaster risk reduction and management offices, for the purpose gathering information disaster areas before, during and after disasters.
- Reduce the dependency of sub-national and local governments on National Government assets, specifically emergency telecoms.

Satellite solution

The new Global Xpress (GX) terminals allow communications at speeds not previously possible for emergency response teams and therefore provide a step change for disaster response. An innovation around Global Xpress allows advanced bandwidth management to improve usage efficiency and thereby keep costs to reasonable levels. Bandwidth management of the satcom solution is critical as there could be some users wasting capacity with heavy video downloads and other bandwidth consuming apps.

BGAN terminals will also be used in this project to complement the larger bandwidth GX solution for smaller regions near the affected city.

Project impact

- Reduced adverse impacts of disasters and reduction in immediate secondary effects.
- Improvements in survivorship, disease, and hardship.
- Lessening of economic damage through reinstatement of basic facilities as rapidly as possible.

Reducing the economic and demographic impact of disasters in Vietnam



Project lead
Astrosat Ltd

Target country(s)
Vietnam

Project consortium
Telespazio Vega

International partners

Long Hai Space Technologies (LHST): a start-up company that commercialises proven space technology, working closely with the Vietnamese government and global institutions. LHST will enable the in-country work (training and physical support presence for the government) as well as ensuring sustainability of the project with the Vietnamese government.

Recovery And Protection In Disaster (RAPID) for Vietnam

Project summary

The project aims to aid the Vietnamese in increasing their social and economic resilience to natural disaster events through the use of satellite and information technology. It will provide the Vietnamese government with a centralised disaster response platform (RAPID) fit for its needs, which fuses satellite and non-satellite information to allow Vietnamese responses to be optimised during disasters. It will also embed RAPID in active operations in a sustainable way by training 40 in-country Vietnamese trainers and rolling it out for a series of back-to-back trials.

Under the supervision of a Vietnamese government space solutions committee, multiple ministries will attach themselves to a continued cycle of operational development, deployment, trialling and review within four government agencies and throughout five municipalities.

The project will also demonstrate and prove RAPID's effectiveness on disaster command response. This measure will be a practical evaluation of how RAPID has improved first response activities in saving lives and protecting property in Vietnam.

Project objectives are to:

- Increase technological and operational prediction of typhoon land fall – location, severity and timing for all of Vietnam.
- For five key municipalities, provide mapping of key 'at-risk' critical infrastructure with updated live space and ground data feeds into the system.
- Enhance flood extent mapping timeliness and effectiveness by providing updated flood maps no more than 12 hours after a typhoon strikes;
- Using space-based capability, provide integrated asset tracking for live Humanitarian Assistance and Disaster Relief (HADR) ground resources for four deployments;
- Demonstrate through field trials with a shadow team a live disaster scenario to prove RAPID increases operational first responder response.

Satellite solution

RAPID utilises SAR Earth observation data from satellites such as COSMO SkyMed to provide low latency images of flood extent, and when complimented by real-time feeds and data gathered from unmanned aerial systems it enables effective decision making when it is needed most. Landsat and Sentinel images produced an archive base map of Vietnam and when modelled alongside weather forecast data we can predict how vital infrastructure and areas are affected at critical times. High Availability Disaster Recovery (HADR) resources are equipped with Global Positioning Systems and front line satellite communications to allow for efficient command and control of assets via the RAPID system during disaster events.

Project impact

- Reduce the economic and demographic impact of disaster-level events in Vietnam.
- 5% reduction in the number of deaths, missing persons and persons affected by disaster each year.
- A reduction in direct economic losses by 0.1% in relation to GDP.
- Support at least one disaster risk reduction strategy in Vietnam.
- Increased acceptance and faith in RAPID as a disaster response tool in at least four disaster situations by at least four Vietnamese ministries.

Harnessing satellite services to improve Kenyan capacity for disaster prevention, response and recovery



Project lead

Avanti Communications

Target country(s)
Kenya

Project consortium
Airbus Defence & Space, Global
RadioData Communications, Torchlight
Group

International Partners

Kenyan Red Cross Society: One of the largest humanitarian organisations in Kenya, with over 80,000 volunteers across 64 branches in all 47 counties.

National Disaster Operations Centre (NDOC): Responsible for disaster and emergency coordination in Kenya, a part of the Ministry of Interior.

Satellite Enablement for Disaster Risk Reduction in Kenya (SatDRR)

Project summary

Kenya is prone to slow-onset natural disasters like droughts, and rapid-onset disasters like floods, land/mudslides and disease outbreaks. Climate change is leading to increases in both the frequency and intensity of natural disasters, whilst population growth, regional unrest and forced population movement drives conflict. The recurrent nature of these disasters in Kenya inherently affects the capacity of communities to recover, which lowers economic output and holds back development year on year.

Effective, well-organised and prepared responses help mitigate the effects of disasters. Satellite systems provide a secure, resilient, always-on infrastructure in disaster situations – providing critical tools for emergency communications and situation assessment.

Working with Government Agencies and the Red Cross Society in Kenya, Avanti and its partners will undertake a Disaster Risk Reduction (DRR) development programme, which will use satellite technology to improve Kenyan capacity to effectively plan for and respond to disasters.

The project will support the development of Kenyan Agencies and Responders by:

- Engaging with Kenyan partners to understand their disaster management priorities, identify solutions and embed capability through policy support, knowledge transfer, specialist training and field exercises.
- Building the capacity of Kenyan staff to prepare, deploy and utilise satellite services for DRR.
- Provide a pilot platform for local actors to deploy satellite communication and Earth Observation services for DRR.
- Enhancing co-ordination, command and control of disaster response at local, regional and national level.

Satellite solution

SatDRR Kenya will demonstrate the added value of satellite services for disaster management. In particular:

- The use of satellite communications to provide both a national resilient infrastructure and effective post-disaster communications where terrestrial alternatives are compromised.
- How EO data can be used to support more effective strategic planning,, situational awareness for delivery of disaster relief and monitoring recovery activities post crisis.

The project will provide secure fixed and mobile satellite communications via Avanti's Ka-band satellite, HYLAS 2, for emergency situations such as famine, floods and disease outbreak; and a flexible web-based dashboard offering a variety of tailored EO information services allowing users to access information on large-scale disasters such as floods and droughts from a variety of satellite data sources.

Access to satellite services will be underpinned by a capacity building and knowledge transfer programme.

Project impact

The overall goal of the project is to strengthen Kenyan capacity (people, processes and technology) for disaster prevention, preparedness, response and recovery through the use of communication and Earth Observation satellite services. This outcome is targeted at creating the following impacts:

- Reductions in human, social and economic impact of disasters on affected communities.
- Increased investment in disaster risk reduction leading to savings in the cost of response and recovery.
- Sustainable exploitation of satellite services leading to ongoing DRR benefits in Kenya.

Improved severe weather resilience for Mongolian herding communities using satellite Earth observation derived environmental services

Project lead
eOsphere Limited

Target Country
Mongolia

Project consortium
Deimos Space UK, University of Leicester,
Micro-insurance Research Centre UK
(MIRCUK)

International Partners

National Agency for Meteorology and Environmental Monitoring of Mongolia (NAMEM): NAMEM's key aim is to promote sustainable development and management of Mongolia's natural, human and economic resources, through the development and appropriate application of remote sensing and GIS technologies.

Agricultural Reinsurance (AgRe): the Mongolian Insurance company, that has been tasked by the Mongolian government with administering the Mongolian Index Based Livestock Insurance scheme (IBLI).

Ministry for Agriculture and Light Industry, Administration for Inter-Aimag Otor Pastureland Use and Co-ordination: responsibility for the sustainable management of pastureland reserve regions.

Center for Nomadic Pastoralism Studies (CNPS): an NGO based in Ulaanbaatar focused on development projects aiming to build resilience in nomadic herding populations in Mongolia.



SIBELIUs: Improved resilience for Mongolian herding communities

Project summary

Mongolia is a large, but extremely rural country with approximately 30% of its population dependant on livestock herding. These populations are exposed to extreme weather events, known as dzuds, which are increasingly exacerbated by climate change and are highly damaging to Mongolia's economy and devastating for the poorest herders. A typical dzud can impact tens of thousands of herders many of whom will lose all their livestock leaving them in extreme poverty, with associated impacts for the wider economy.

SIBELIUs will provide greater dzud-resilience for herders by providing Mongolia's National Agency for Meteorology and Environmental Monitoring (NAMEM) with improved capacity for distributing new and upgraded environmental products to key stakeholders supporting herding communities. A aspect of the project is to channel the benefits of improved products through three existing networks:

1. The Mongolian Index Based Linked Livestock Insurance scheme (set up by the World Bank in 2006).
2. Otor Grazing Reserves which provide emergency grazing for use in dzuds.
3. NAMEM's existing network of regional centres.

As a vital component of the project, SIBELIUs will work with herders at selected case study sites to analyse their information requirements, to better understand barriers to uptake of previous insurance products, and to ensure their voices and priorities are heard in the development and distribution of new satellite-based environmental products.

Satellite solution

SIBELIUs will improve the dzud-resilience of the Mongolian herding population by integrating satellite-derived environmental information into existing

government and insurance networks. Mongolia's herding communities can be devastated by dzuds, usually comprising a dry summer, adversely affecting pasture growth, followed by a cold winter with deep snow. Key satellite derived products will include those providing information on grazing capacity, snow depth and 'dzud risk maps' aiming to predict the likelihood of a dzud events in advance.

Project impact

- Improve the dzud-resilience of the Mongolian herding population by better integrating new satellite-derived environmental information into existing government and insurance networks.
- Assist in building capacity at Mongolia's National Agency for Meteorology and Environmental Monitoring (NAMEM) for distributing new and upgraded environmental products to key stakeholders supporting herding communities.
- Work with local stakeholders, including herding households at case study sites, to co-produce and design products, in order to take account of their needs and requirements.
- Provide access to new sources of satellite data to facilitate new improved high resolution regionally sensitive dzud prediction products and grazing capacity information for distribution to end users: regional meteorological centres, the insurance sector and the Otor Reserve Administration.
- Aim to decrease the number of directly affected persons and direct economic losses attributed to dzud related disasters.
- To further develop and strengthen links between UK and Mongolian institutions for better understanding and tackling climate-related extreme events.

Increasing resilience to coastal hazards

Project lead
Satellite Oceanographic Consultants Ltd (SatOC)

Target country(s)
Madagascar, Mozambique, South Africa

Project consortium
National Oceanography Centre, Bilko Development Ltd

International partners

Mozambique

National Institute of Hydrography and Navigation (INAHINA): The Mozambican hydrographic institute, INAHINA, has the mandate to provide information for navigation and deliver research into maritime aids for navigation.

Eduardo Mondlane University: the primary national institute for applied coastal and oceanographic research.

Madagascar

National Oceanographic Research Centre (CNRO): a specialised research organisation for applied Oceanographic Research.

Institute of Fisheries and Marine Science (IH. SM): undertakes training and research in the field of marine sciences, fisheries and aquaculture, marine and coastal environment.

Government Department of Meteorology (DGM): National Government Department responsible for delivering national forecast services.

WWF Madagascar Conservation International: remit of biodiversity conservation and assessment.

South Africa

Council for Scientific and Industrial Research (CSIR): CSIR is one of South Africa's public research institutions mandated to support improvement to the quality of life of the people of the Republic through directed multidisciplinary research and technological innovation.



Coastal Risk Information Service (C-RISe)

Project summary

C-RISe will be carried out by an international partnership between the UK, Mozambique, Madagascar and South Africa to provide satellite-based information on sea level rise, storm surges, extreme wind speeds and wave heights. Information will be provided via a dashboard that meets local priorities. Local users will be trained to use the satellite data so they can provide scientific support for strategy development, governance and management of coastal areas to help increase their resilience.

The goal is to enable local stakeholders to use this information to reduce the social and economic impact of coastal hazards and increasingly variable weather patterns. C-RISe will enable stakeholders to obtain information about coastal vulnerability that is not currently available; this increased capacity will enable them to evaluate and plan for future risks.

C-RISe will be carried out over a three-year period, consisting of a first phase of defining the user requirements, a second phase of data application and training, and a third phase of service evaluation. The project will be carried out by a core team of scientists from research institutes in each respective country, working with government departments and NGOs.

Satellite solution

Satellite altimeters have been providing continuous global measurements of sea level, ocean wind speeds and wave heights for over 25 years, and provide a key contribution for monitoring climate change. However, there is a difficulty in retrieving accurate measurements close to the coast.

An innovative processing technique has been developed in the UK to retrieve this data, and is applied, in this project, to data from the Jason¹ series of altimeter satellites for the Mozambique, Madagascar and South Africa coastal regions. The coastal altimeter data generated will be delivered through a web-based portal, and the project team will support local partners in using the data, working with them to develop a range of case studies to demonstrate how the data may be used in different application areas.

Project impact

- Build local capacity to use satellite information products in support of strategy development, governance and management of coastal areas to increase resilience to coastal hazards.
- Establish a sustained local scientific and technical capability to access and use marine satellite data within a regional network, with links to UK expertise and support.
- Operational uptake of C-RISe-enabled data in commercial and industrial sectors to improve competitiveness and safety.

¹ Joint Altimetry Satellite Oceanography Network

Using satellites to improve fisheries management and tackle illegal fishing in the Philippines



Project lead
Janus TCD

Target Country
The Philippines

Project consortium
Nick Lambert Associates Ltd (NLA Ltd),
BSMART, OceanMind, Poseidon Aquatic
Resource Management Ltd

International partners

The National Coast Watch Centre, Philippines:
co-ordinates activity between and assets
belonging to:

- The Philippine Coast Guard
- Bureau of Fisheries and Aquatic Resources
- The Philippine Navy
- The Philippine National Police-Maritime Group



Improved Situational Awareness In Fisheries (ISAIF)

Project summary

The Bureau of Fisheries and Aquatic Resources (BFAR) in the Philippines has identified several core problems of the fisheries sector, notably loss of marine biodiversity, declining fish stocks, and loss of revenues from fisheries and coastal resources. These problems have been attributed to illegal, unreported and unregulated fishing (IUU) including destructive fishing, overfishing, coastal and habitat degradation, siltation, pollution, post-harvest losses and inefficient marketing.

The premise of ISAIF is to establish a system that supports improved situational awareness within fisheries management systems in the Philippines. The ISAIF system will enable the Philippine Government to reduce the impact of Illegal, unreported and unregulated fishing (IUU).

The project will help the Philippine government to better understand, benchmark, monitor and support the activity of 4 million largely unmonitored artisanal fishers. Further steps need to be taken to authenticate the fishing catch by this sector to support legal, sustainable fishing.

Because so few of the fishing vessels have tracking units that could enable effective monitoring, there is a critical need to evaluate different technologies as well as for analytical support and capacity building to relevant agencies to promote the monitoring and control required for sustainable fisheries.

There is also a tremendous need for the application of technologies and techniques that can help identify 'dark vessels' that do not transmit an identifier that would enable oversight of their activities. These may be Philippine flagged vessels engaged in IUU fishing in closed areas such as the nearshore exclusion zone for artisanal vessels, or could be foreign flagged vessels illegally encroaching on the waters of the Philippines Exclusive Economic Zone.

Several remote sensing technologies could be used to detect these dark vessels, ideally in parallel with a fisheries analytic capability to cross-reference a database of threat profiles and other tracking systems to quickly and clearly provide threat assessments to efficiently deploy an enforcement

response. Unlike traditional solutions, this project will demonstrate both conventional satellite-based IUU fishing techniques combined with innovative and potentially disruptive low-cost satellite navigation based technology. This will allow – for the first time – not only coverage of commercial fishing activity, but coverage of subsistence artisanal fishing, which up until now has been excluded from conventional fishing monitoring technology due to the (relatively) high cost.

This will help to protect and grow a fisheries sector that contributes approximately \$1.2bn to the country's GDP, supplies over 50% of animal protein consumed by the population and employs more than 4 million people.

Satellite solution

The advent of commercially available data sets derived from space based sensors such as optical, SAR, AIS, VMS and emerging technologies is transforming maritime situational awareness. Over the past decade, these capabilities have in particular been developed in combatting IUU fishing with the fusing of archive and terrestrial data sets to create near and real-time information systems for fisheries management compliance and enforcement. The best combination of such services – as defined by the International Partner – will be explored, scoped and delivered during the project.

Impact

ISAIF will:

- Improve local institutional capacity for monitoring and enforcement.
- Deliver near-term economic benefits to the Philippine economy from reducing illegal fishing and/or regularising unreported activities.
- Deliver long-term improvement in the national interest for extraction of protein source from the sea to feed a growing population.
- Strengthen the international reputation and engagement opportunities of Philippine fisheries.

Reducing illegal, unregulated and unreported fishing in Chile



Project lead
Satellite Applications Catapult

Target country(s)
Chile

International partners

Directemar: Chilean Navy, which provide resources and assets to the projects.

Satellite Enabled Maritime Domain Awareness for Chile (SEMDAC)

Project summary

Illegal, Unregulated and Unreported (IUU) fishing is estimated to cost the global economy \$20 billion annually and is a cover for other illegal activities such as slavery and smuggling. It robs legitimate fishers and governments of revenue, undermines the accuracy of fisheries' stock assessments, and thus thwarts efforts to responsibly manage marine fisheries, damaging their productivity and in some cases precipitating their collapse. Ultimately IUU threatens the stability of coastal communities that rely on the legal trade. The tools and techniques being developed and demonstrated in this project will assist in tackling all these issues.

Chile is the 10th largest fishing nation in the world at 1.5% of the world's global catch and is estimated to lose \$150 million in lost revenues per year due to illegal fishing. Any substantial increase in detection and prosecution will therefore make a significant contribution to the Chilean economy.

The project's aim is to demonstrate the efficiency of using satellite data and algorithms in detecting IUU fishing in Chile's Marine Exclusive Economic Zone (EEZ). The purpose is to evaluate the cost effectiveness of the techniques and to estimate the socio-economic impact of implementing a sustainable service. The project has completed a successful trial to detect IUU fishing within Chile's EEZ, and potential IUU vessels have been identified.

Satellite solution

The SEMDAC project will monitor and analyse the following data sources:

- AIS vessel tracking information from satellites and ground-based receivers, and VMS vessel tracking information where it is made available by the relevant authority.
- Observation information from SAR satellites used to detect vessels not transmitting on AIS or VMS.
- Global vessel registry information from official sources.
- Authorised vessel lists, including Regional Fisheries Management Organisations' (RFMO) regional vessel registers and authorised transshipment vessels to correlate and understand tracking information and advice on any appropriate enforcement activities.
- Specialist and registered fisheries' enforcement databases maintained by enforcement analysts and agencies relating to illegal fishing and similar environmental crime;
- Other sensor information such as position reports from vessel or air patrols, sightings of opportunity by passing ships, buoy data, Unmanned Surface Vehicle data, UAV data, etc.

A specialist fisheries analyst with extensive enforcement experience analyses and interprets the computational results of the system in order to produce regular activity reports, and, as necessary, incident reports, including detailed analysis of vessel activity and history as well as providing incident response recommendations. The fisheries analyst also liaises with relevant regional authorities to ensure that information control processes and activity plans are co-ordinated effectively.

Project impact

Reduce IUU fishing by improving visibility and efficiency of analysing suspicious behaviour.

Tracking small boats to increase their safety in South Africa and Madagascar



Project lead
exactEarth Europe Limited (eEE)

Target country(s)
South Africa and Madagascar

International partners

South Africa

South African Maritime Safety Authority (SAMSA): government organisation which leads on maritime safety.

National Sea Rescue Institute (NSRI): charitable organisation which undertakes sea rescues.

Marine Data Solutions (MDSol): provides technology solutions to Africa's maritime authorities and associated industries.

Stone Three Venture Technology: develops bespoke enterprise software engineering solutions for industry leaders.

Madagascar

The Maritime Data Analysis Centre (CFIM): advises on the presence of illegal fishing, piracy, tampering of natural resources, maritime terrorism or maritime cybercrime.

South Africa Safety Initiative for Small vessels' Operational Take-Up (OASIS-TU)

Project summary

eEE have developed a satellite AIS (SAT-AIS) based technology to address the problem of practical tracking of small boats in developing countries – exactTrax – as demonstrated on eEE's OASIS project funded under the UK Space Agency's pilot programme (International Space Partnership Programme). This saw a successful trial of exactTrax in partnership with SAMSA. Small fishing, work and leisure boats account for the majority of South African maritime accidents and incur millions of Rand annual expenditure on search and rescue activities. Knowing the up-to-date location of a boat is vital to saving lives and reducing search and rescue costs by thousands a year.

SAMSA is now mandating the use of SAT-AIS tracking for small boats but requires initial assistance in its operational roll-out. OASIS-TU will deploy, under a new marine regulation, an initial 1,500 em-trak I100 AIS identifiers across the poorest/most at-risk small boat sector in South Africa (small-scale fishing boats <10 metres). exactTrax' operational data services will be established through the South African company, MDSol, to underpin the project and beyond as the mandate rolls out. By working with MDSol and Stone Three, the project will grow South African business.

OASIS-TU will also partner with the South African NSRI (equivalent to the UK's Royal National Lifeboat Institution) to broaden the availability/use of tracking data by safety organisations. If a boat's last location is known, or the em-trak I100 AIS identifier's SOS function is activated, authorities can better target where to search, and can rescue sailors more quickly, saving both lives and money.

Finally, to widen platform options downstream to the economic benefit of South Africa through exports, OASIS-TU will partner with Stone Three, who will integrate exactTrax into their AIS product line and trial it with the Madagascar CFIM.

Satellite solution

The project is working with SAMSA to equip boats with battery-powered AIS em-trak I100 AIS identifiers. These devices can then be tracked in near real time by exactEarth's constellation of polar and equatorial orbiting AIS satellites, and therefore provide South African and Madagascan authorities with an up-to-date last-known position. The devices also provide an SOS button which will transmit a distress message if an incident occurs, and which is also detected by exactEarth's satellites. This information will be integrated into their search and rescue systems alerts to inform authorities quickly.

Project impact

- Reduction in small boat deaths at sea around South Africa.
- Local South African company growth through increased sales.
- Significant reduction in expenses related to search and rescue.

Using satellites to improve safety, economic productivity and food security for small and mid-scale fisheries in Indonesia



Project lead
Inmarsat

Target country(s)
Indonesia

Project consortium
Satellite Applications Catapult, Poseidon Aquatic Resource Management Ltd

International partners

Ministry of Marine Affairs and Fisheries (KKP): Indonesian ministry committed to developing fisheries that are competitive and sustainable for the wellbeing of local fishing communities, as well as the broader Indonesian economy.

Satellites for sustainable fishing

Project summary

The Indonesian fishing sector is a critical driver of the economy and society, supporting 7 million fishers. Fishing not only supports millions of households but is also part of a valuable global export business. However, environmentally unsustainable fishing, including illegal and unreported fishing, harms the entire value chain, as well as introducing safety and security challenges.

This project uses fishing Vessel Monitoring Systems (VMS), whereby equipment that is installed on fishing vessels provides information about the vessels' position and activity. By expanding the use of VMS, this programme will incentivise fishers to actively use them by:

- Designing additional services to be carried by VMS – safety and comms.
- Designing new operational protocols for policing and fisheries management.
- Reducing illegal fishing to conserve fishing stocks.

In addition, by working closely with the KKP to create the right processes to interpret and react to the data generated, it will:

- Strengthen the surveillance capabilities of the Ministry.
- Improve the policing of illegal fishing and conservation areas.
- Move the industry onto a more sustainable and profitable basis.
- Provide valuable industry information on catches and sourcing to improve fishery management.

Satellite solution

Inmarsat L-band satellites provide highly reliable global coverage of vessels at sea, with a range of services that allow incremental value delivery to address different fisher demographics. The Inmarsat-4 constellation offers two connectivity services: IsatData Pro and Fleet One.

IsatData Pro (IDP) is an Internet of Things (IoT)-optimised messaging system capable of delivering tracking and basic two-way communications such as text messaging, emergency alerts, and form submission (e.g. electronic catch reports) at a very low cost point appropriate for small vessels and tightly constrained budgets. Fleet One (a maritime version of the BGAN network) enables a more rich application environment for productivity tools, includes voice capabilities and standardised safety services. Services are delivered to the fishers in both cases through a low-cost tablet on board the vessel, working in concert with a small embedded computer to minimise satellite data costs.

Project impact

- By 2018, improved safety, economic productivity and food and livelihood security for small and mid-scale fishers in Indonesia through expanded adoption of VMS – directly benefiting 2,000 fishers and 10,000 dependants.
- Reduction in Illegal, Unreported, and Unregulated (IUU) fishing in Indonesian waters.

Transforming the learning environment in schools by using satellites to improve Information and Communication (ICT) in rural areas



Project lead
Avanti Communications

Target country(s)
Tanzania

Project consortium
Ace Africa (Majibu) and Jigsaw Consult

International partners

Discovery Learning Alliance: uses the power of media to transform education and improve lives in under-resourced schools and communities.

Camara Education Limited: an international organisation dedicated to using technology to improve education and livelihood skills in disadvantaged communities.

Universal Communications Service Access Fund: fosters social and economic development in rural and urban areas through ICT intervention.

Tanzanian Education Authority: a corporate body established to manage the Education Fund in Tanzania.



iKnowledge

Project summary

The overall aim of iKnowledge is to transform the learning environment in schools for children and teachers in Tanzania through improved sustainable infrastructure, teacher development and enhanced use of quality educational content.

Teachers in Tanzanian schools do not have adequate internet access or online resources for teaching. The project delivers internet access to more than 250 schools across Tanzania and has also set up example schools in other African countries. Selected Academy and Teaching Lab schools are also provided with online educational resources. As part of the sustainability plan, a few selected iKnowledge schools are installed with a Wi-Fi Community Access Point to generate revenue to subsidise internet access.

The expected outcome of the project is to provide a sustainable level of ICT literacy for school teachers and sufficient revenue generated through the network.

Project objectives are to demonstrate to in-country stakeholders how satellite services can support e-education in Tanzania, with a specific focus on sustainable business models and professional development and support for teachers. The project is built on four main pillars:

- **Connect:** develop and demonstrate a scalable service that combines internet, mobile access and broadcast as a way to deliver educational content to teachers in schools.
- **Deliver:** open the network to content providers from within Tanzania and elsewhere, catering for the educational curriculum.
- **Train:** instruct teachers to maximise use of the educational content in the classroom.
- **Sustain:** establish mechanisms to assure the operational sustainability of the service beyond the initial project period by using the infrastructure to generate income through schools.

Satellite solution

The project is using Avanti's HYLAS 2 Ka-band satellite, which is specifically designed to provide high-speed coverage for customers located in areas lacking or poor terrestrial or Global System for Mobile Communications (GSM) coverage. This will provide broadband connectivity which will be utilised by school teachers to access and deliver online educational content for classroom teaching and administration activities.

Project impact

- Increased and sustained ICT service provision through local partnership and satellite services in Tanzania.
- Increased teacher competence to integrate internet-based ICT in their teaching and learning practices.
- Increased local capacity and will to sustain the service.

Forecasting and providing early warning of Dengue fever outbreaks in Vietnam through Earth Observation



Project lead (company)
HR Wallingford

Target country(s)
Vietnam

Project consortium
London School of Hygiene and Tropical Medicine, UK Met Office, Oxford Policy Management

International Partners

United Nations Development Programme (UNDP): Liaison with Vietnamese stakeholders over the three years of the project; Management and disbursement of funds to the World Health Organization (WHO).

World Health Organisation (WHO): Direct liaison with relevant government ministries and agencies, provision of historical dengue data and management of capacity building for the health side of the project.

The National Institute of Hygiene Epidemiology (NIHE); part of the Ministry of Health in Vietnam. Oversees the prevention and control of epidemic and common diseases, including dengue fever.

Pasteur Institute Ho Chi Minh City (PIHCMC): An international key player in global health, in constant dialogue with local authorities, research institutions, and major international organisation.

Institute of Meteorology, Hydrology and the Environment and Climate Change (IMHEN): Provision of historical hydrological data to the project, expert advice and input into the development of an EO based water level monitoring and water assessment tool



Dengue fever Early Warning System (DEWS)

Project summary

Dengue fever is the most rapidly spreading, mosquito borne, viral disease in the world. Dengue flourishes in urban poor areas, suburbs and rural areas but also affects more affluent neighbourhoods in tropical and subtropical countries. Since 2000, there has been an increase of over 100% in the number of cases of dengue fever in Vietnam alone.

Dengue fever occurs in 141 countries, including Vietnam, where there is currently no system to forecast the probability of future dengue outbreaks. This project will provide a tool giving advance warning, of several months, of likely dengue outbreaks. This will greatly assist public health authorities to mobilise resources to those most in need. The same methods could also be used to forecast outbreaks of Zika, which has recently begun to be reported in Vietnam.

This is the first time a dengue prediction tool will have been designed that links Earth Observation products and hydro-meteorological variables to vector-borne disease incidence at a local scale. The Earth Observation-based forecasting system will allow decision makers to identify areas of high risk for disease epidemics before an outbreak occurs, in order to target resources to reduce epidemic spreading and increase disease control. The project will also provide projections of dengue fever under a range of climate change scenarios.

As the dengue forecasting tool will also include a water assessment module, the work will also help to improve water management in Vietnam's transboundary river basins where there is a lack of hydro-meteorological information.

Satellite solution

Earth Observation datasets will be combined with health and water availability information to produce a new integrated dengue forecasting model. The model will link Earth Observation data with climate

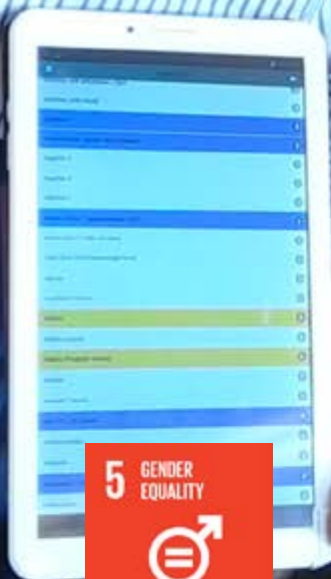
forecasting and a land-surface model to understand and predict the impacts of primary stressors, (including water availability, land-use, climate), on the likelihood of future dengue epidemics. The tools produced will be used to understand changing health risks posed by dengue for different temporal and spatial scales under future climate change scenarios.

The use of Earth Observation data and space technology will greatly enhance the on-the-ground collection of data, especially in the remotest areas of the country. When compared to ground stations (e.g. weather stations), remote-sensing products enable a more accurate representation of the spatial variation of meteorological parameters, which may vary significantly at the local scale, particularly in regions with high elevation variation. Earth Observation data also enables scalability of the solution up to national or even international level.

Project impact

- At least 10% reduction of the incidence of dengue fever: In the pilot provinces, we expect the incidence of dengue fever to go down over the project lifetime, because local communities will be better able to mobilise to eliminate mosquito-breeding sites in response to early warnings of dengue epidemics.
- 15% higher Ministry of Health response rate to dengue outbreaks: increased proportion of dengue warnings that are acted upon by the Vietnamese government by providing early warnings of dengue epidemics at a province level.
- At national level, the project will strengthen the capacity of Vietnam for early warning, risk reduction and management of national and global health risks; as well as contribute to increased resilience to future dengue and Zika epidemics by shaping policies related to disease prevention and control under future climate-change scenarios.

Using Satellites to extend the reach of basic medical healthcare into remote areas, improving health service delivery in Nigeria



Project lead
Inmarsat

Target country(s)
Nigeria

Project consortium
InStrat, Nuffield Centre for International Health and Development of the University of Leeds

International partners

Federal Ministry of Health: responsible for the formulation, dissemination and implementation of health policies in the country.

SatCom for Nigerian Health Services

Project summary

This project addresses a key development need by extending the reach of basic medical services into remote areas of Nigeria, delivering professional training, data collection and disease monitoring. It uses Inmarsat's BGAN satellite technology to host communications which will:

- Provide video-based health worker training.
- Improve health systems management and governance using an information system application.
- Improve disease surveillance capabilities.

The project will operate at 78 sites in Kano, Lagos and Ondo states as well as the FCT, bringing the national standard of healthcare to the most remote areas. Video-based training will be provided to health workers to an agreed government standard. It will be achieved by using satellite connectivity infrastructure by providing solutions to overcome connectivity challenges to improve healthcare at the last mile.

It will directly improve health provision and creates a model which can be extended into other parts of the country.

Satellite solution

Satellite connectivity will be provided by 2-piece BGAN, accessed by a local tablet with content repository. A Local Wi-Fi network will be installed with access to a variety of Wi-Fi-enabled devices / access points including:

- Feature phones (Wi-Fi-enabled).
- Smartphones.

- Tablets.
- PCs / laptops.

Project impact

By 2021, remote, technologically disadvantaged rural communities in Nigeria have better access to health care services, specifically:

- Access to better health treatment standards improved for service users across 78 communities.
- Access to training and health systems solutions improved for 400 rural health workers.

By 2021, ensure healthy lives and wellbeing of all ages in the population and strengthen Nigeria's core capacity for managing national health risks, specifically:

- At least 50% of births assisted by skilled health personal (vs 38% now).
- Marked improvement in the % reduction of birth complications.
- Increase (by at least 30% compared to baseline) in Nigeria's core capacity to generate and utilise e-health data to inform policy and decision making.

Space-based dam monitoring

Project lead(company)
HR Wallingford

Target country(s)
Peru

Project consortium
Telespazio VEGA UK, Siemens, Satellite Applications Catapult, Oxford Policy Management, Smith School of Enterprise and the Environment (University of Oxford)

International partners:

CIEMAM: leading mining consultancy specializing in engineering, strategy, development and environmental actions maintenance.

Universidad Nacional de Cajamarca: Escuela de Ingeniería Hidráulica, Facultad de Ingeniería (National University of Cajamarca, School of Hydraulic Engineering and Faculty of Engineering) are involved in teaching and research activities from their respective fields. They will play a key role in knowledge sharing aspects of the project as well as assist in some technical aspects.

Fundación Nacional de Ingeniería Hidráulica (National Foundation for Hydraulics): carries out studies and projects related to hydrology and hydraulics throughout Peru with the objective of minimising natural hazards.



Reducing the probability of failure of tailings dams through the use of remote sensing data

Project summary

Tailings dams are earth embankments used to store toxic mine waste and effluent which can be more than 100m high. They are often constructed with steep slopes using the tailings to save on costs. Keeping these structures intact over many decades is challenging. Their rate of failure is high, owing to inadequate design regulations and less rigorous construction methods than for normal water-retaining dams, especially in low-income countries. The rate of tailings dam failures is increasing, with 50% of serious tailings dam failures in the last 70 years occurring between 1990 and 2010. Tailings dams often contain hazardous substances that can contaminate food chains and drinking water.

There is a need for a cost effective service to both monitor operational and abandoned tailings dams, especially those in remote locations, and to help forecast potentially catastrophic failures. This project will utilise satellite technologies combined with real-time in-situ devices to provide a more cost-effective way of remotely measuring displacements of tailing dams and other mining infrastructure. This will reduce the probability of dam failures and pollution incidents. The project involves local stakeholders and representatives of the mining industry in Peru to test this approach on a number of operational and abandoned tailings dams. This project will help to reduce damage to ecosystem services downstream of mines upon which many vulnerable communities rely for both their source of water and their livelihoods.

Satellite solution

The project solution is based on combining satellite Synthetic Aperture Radar (SAR) interferometry and real-time Global Navigation Satellite System (GNSS) with a goal of achieving a high level of automation for dam monitoring.

Satellite imaging provides a clear and comprehensive ability to observe, measure, qualify and quantify over wide areas with a very high frequency.

Structures can be monitored with a high degree of accuracy and precision regardless of the relative inaccessibility and hazardous nature of the terrain in remote locations where tailings dams are often located.

Space observation complements in-situ measurements. GNSS can provide fully automated motion monitoring in 3D and real-time to an accuracy of a millimetre for a discrete number of points by means of affordable GNSS receivers on the ground. InSAR provides infrequent, near-vertical movements of a large number of points over a wide area also to millimetre accuracy without any equipment on the ground. Together a complete reservoir motion monitoring can be achieved.

Project impact

The Earth Observation-based tools developed as part of this project will be less expensive and require less expertise to employ than existing monitoring methods. This project uses emerging remote sensing technologies to dramatically increase the speed and effectiveness of monitoring the dams as a tool for improved governance of the extractive sector. By providing affordable, accurate and timely information to decision-makers, non-governmental organisations and environmental regulators this project will result in greater transparency and capacity for low income countries to govern mining activities. This will lower the probability of failure of these structures and the associated downstream risk, thus benefiting vulnerable downstream communities who are reliant on the downstream ecosystem services.

Improving property tax revenue by using satellite imagery analysis to enhance a property database in Dakar City, Senegal



Project lead
Airbus Defence and Space

Target country(s)
Republic of Senegal

Project consortium
N/A

International partner

New Africa Consulting, Dakar: a specialist in developing public-private partnerships in Senegal. New Africa Consulting lead on the interaction with Dakar's Mayor's Office and the National Tax Authority.

Property database for Dakar City

Project summary

The Dakar City government has a requirement to generate revenues for developing and maintaining city infrastructure and services. The legal framework for property taxation is already in place, but the city lacks the resources to collect and maintain the information needed to calculate the tax due. The Airbus system links specific textual information such as ownership and address with location and building characteristics, including size and value; all essential data for generating municipal revenues based on property taxation. Using very high-resolution satellite data, the land and building extents (and heights) can be effectively monitored through a combination of image analysis and field data collection. Change detection through satellite imagery analysis can greatly improve the efficiency of the monitoring process.

This system will provide the framework for field teams to collect and maintain accurate property characteristics enabling tax calculations to be made within a fully operational system to support sustainable and transparent revenue generation for Dakar City. Focusing on training and knowledge transfer will ensure that future operations can be fully implemented by a local technical team.

The system will therefore be self-financing and could be rolled-out to other cities in a similar position. Local authorities are working with the National Revenue Authority to ensure that the city and its citizens will benefit from enhanced services and economic opportunities.

Satellite solution

This project is designed to develop an operational system for creating and maintaining a parcel reference map, whose accuracy can be further improved through Global Positioning System (GPS) based field survey, and mapping new buildings and changed building heights through 3D monitoring based on satellite imagery.

Project impact

- Evidence that property tax collection can be improved.
- Identification of how improved revenue collection could be used for enhanced planning, development and maintenance of service infrastructure in key target areas, including water and drainage, citizen security, and maintenance of open spaces.
- Projected increase in job opportunities and roles created in local government by up to 20% for property data maintenance and ongoing tax collection, as well as service provision and infrastructure maintenance by 2019.

Supporting Small Island Developing States' transition from fossil fuel electricity generation to renewable energy

Project lead
Institute for Environmental Analytics (IEA)

Target country(s)
Seychelles, Mauritius, St Lucia, Montserrat, St Lucia, Montserrat, Tonga, Palau and Vanuatu.

International partners

Ministry of Environment, Seychelles Energy and Climate Change: responsible for all matters concerning environment, renewable energy and climate change affairs (including mitigation and adaptation actions).

United Nations Development Programme (UNDP): Helps to achieve the eradication of poverty and the reduction of inequalities and exclusion.

Rocky Mountain Institute: Aims to transform global energy use to create a clean, prosperous and secure low-carbon future

Ministry for Infrastructure, Ports, Energy and Labour (Renewable Energy Division), St Lucia.

St Lucia's Electricity Services Limited (LUCELEC).

Ministry of Communications, Works, Energy and Labour (MCWEL), Montserrat.

Montserrat Utilites Limited (MUL).

Ministry for Energy & Public Utilites (MEPU), Mauritius.

Central Electircity Board (CEB) Mauritius.

Ministry of Meteorology, Energy, Information, Disaster Management, Climate Change and Communions, Tonga .

Tonga Power Limited.

Ministry of Public Infrastructure, Industries and Commerce - Palau Energy Administration.

Palau Public Utilities Corporation.

Ministry of Climate Change Adaptation (MoCCA) , Vanuatu.

UNELCO Engie - Vanuatu.



Renewable Energy Space Analytics Tool (RE-SAT)

Project summary

The RE-SAT project is developing a software platform with associated data products and modelling tools to support Small Islands Developing States (SIDS) in their transition from fossil fuel electricity generation to renewables.

SIDS have enormous potential to be energy-independent due to their natural renewable energy (RE) resources. To date, many SIDS have insufficient environmental data and rely on incomplete records to plan their RE strategy. This leads a greater reliance on traditional (fossil fuel) generation mechanisms as back-up to balance the grid.

To overcome this data gap and to support SIDS to improve their strategic RE planning, RE-SAT is using EO and other sources of environmental data to support decision-making regarding the feasibility and location of RE systems. RE-SAT will:

- Offer SIDS a powerful visualisation tool to support strategic planning around defining the best renewable energy mix, planning where to locate different assets and also how to manage demand, taking account of environmental variables such as projected and historic weather patterns.
- Minimise the risks in investing and make the transition to renewable energy a reality for SIDS.
- Propose a low carbon pathway for sustainable development amongst some of the most environmentally vulnerable nations on the planet

RE-SAT Phase 1 delivered a successful proof-of-concept energy-planning platform in collaboration with the Government of Seychelles. Phase 2 aims to scale-up RE-SAT by applying it to six targeted SIDS that are leading the transition to renewable energy in the Caribbean, Indian Ocean and Pacific region. The aim is to further develop RE-SAT to support these six SIDS as they plan to increase the penetration of renewable energy production, mitigating the financial risk of over reliance on fossil fuels for local economies.

Satellite solution

The IEA will use freely available EO datasets to: augment limited ground-based observations in SIDS; validate computer simulations of relevant RE variables; investigate the potential of using existing ocean data products to simulate the future use of Ocean Thermal Energy Conversion (OTEC) and Wave Energy devices; explore satellite based thermal data for geothermal energy prospecting.

The aim is to use satellite data to enhance ground based estimates of environmental factors relevant to the production of renewable energy, such as irradiance, wind speed, wave height and ocean temperature.

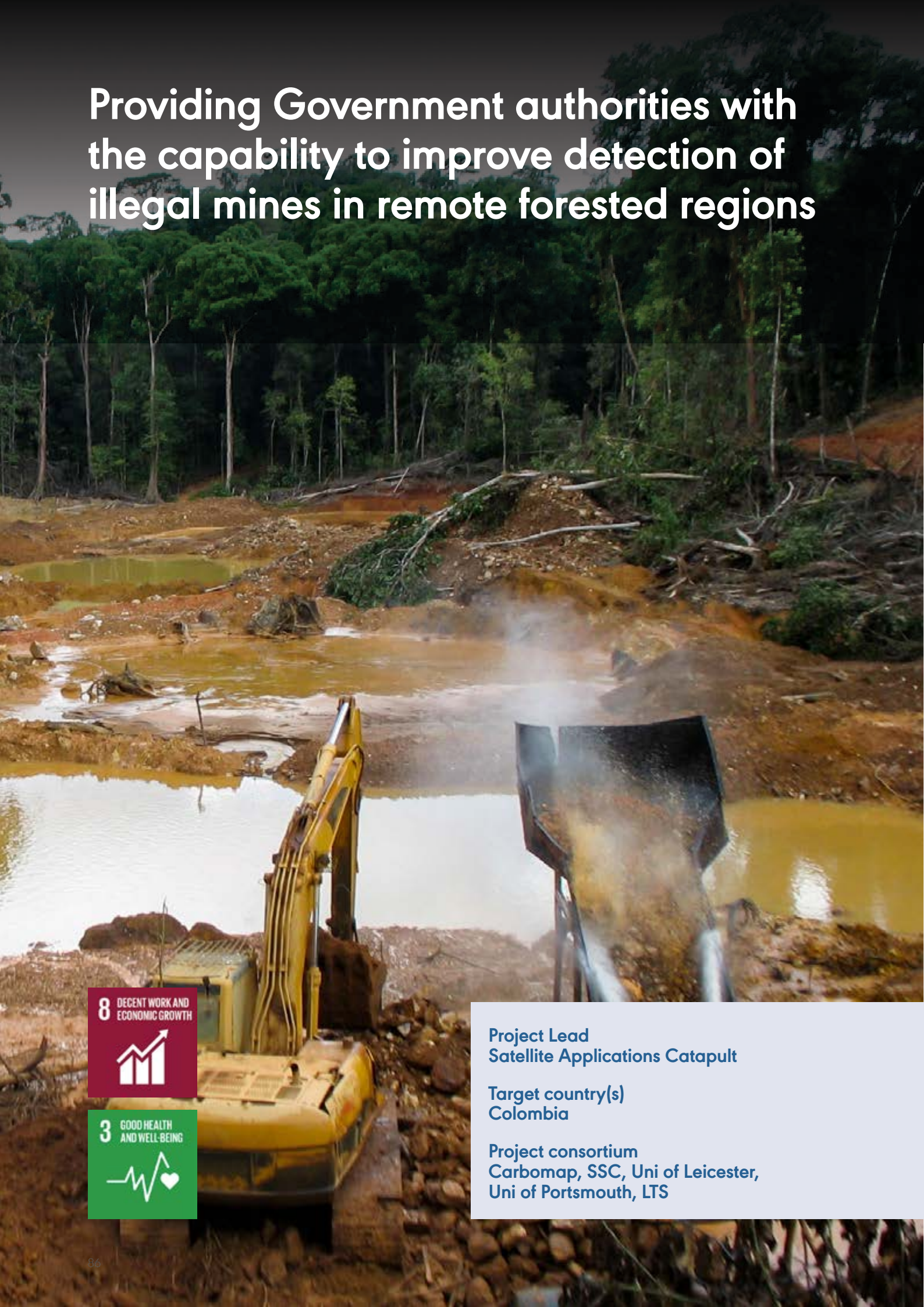
Phase 1 impacts

- Improved accuracy of data for decisions about the energy mix, required grid infrastructure and battery sizing – leading to potential government savings on unnecessary infrastructure costs.
- Appropriate RE technology capacity building – leading to Seychelles being better equipped to plan their future RE infrastructure.
- Improved evidence-based quantification of RE network risks and environmental impacts.

Phase 2 impacts

- SIDS able to access improved data on intermittent renewable energy resources for planning activities such as investment appraisals of RE installations or studies for grid upgrades.
- SIDS able to define and agree clear stages of development in their strategy for high levels of penetration of intermittent RE resources, thus improving coordination of the multiple activities needed to deliver a complex transition in energy generation.

Providing Government authorities with the capability to improve detection of illegal mines in remote forested regions



Project Lead
Satellite Applications Catapult

Target country(s)
Colombia

Project consortium
Carbomap, SSC, Uni of Leicester,
Uni of Portsmouth, LTS

Space Enabled Monitoring of Illegal Gold Mining

Project summary

Illegal gold mining is a billion dollar trade which causes devastating impacts on local communities and the environment.

Mercury is used by illegal mining operations to extract the gold from the ore, it then enters the atmosphere through smelting operations in local towns, or seeps into the surrounding soil, rivers and the food chain causing serious health problems such as kidney failure, acute anaemia and brain damage in new-borns.

This project will enable authorities to increase their capabilities in the detection of illegal gold mining activity in remote forested areas, without putting their personnel at risk. The first barrier to stopping the illegal mining is locating where it is taking place and understanding the scale of the problem.

The ability to identify potential areas for further investigation will support the Government's efforts to offer individuals working illegally the opportunity to comply with regulation and ensure that safe employment practices are adopted. In turn, this will help reduce the health-related effects of mercury contamination associated with illegal mining.

Using freely available Synthetic Aperture Radar (SAR) data, and incorporating machine-learning techniques, the team intend to develop a software tool that could show suspected areas of illegal mining.

Satellite solution

The project will use a combination of satellite data sources coupled with machine learning to derive sites of illegal mining associated with areas of deforestation in Colombia. The solution will heavily rely upon the Sentinel-1 radar constellations (A and B) alongside additional data sets to acquire frequent cloud-free imagery over the country. Once areas of deforestation have been identified, machine-learning techniques will be used to associate each area with a probability of the presences of illegal mining. Previous identified sites of illegal mines will be used to train and validate the machine-learning algorithm. High resolution optical satellite imagery will be acquired over the areas which remain ambiguous in their nature.

Project impact

Improving the ability to detect and monitor illegal gold mines will support the Colombian Government's existing process so that safe and legal employment practices are adopted, and human rights are protected. Specifically:

- Promoting development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services (disaggregated by gender).
- Facilitating a 20% reduction of mercury entering the ecosystem, leading to a 30% reduction in newborn mercury poisoning incidents in the Antioquia region by 2030 and beyond.
- By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination (disaggregated by gender).

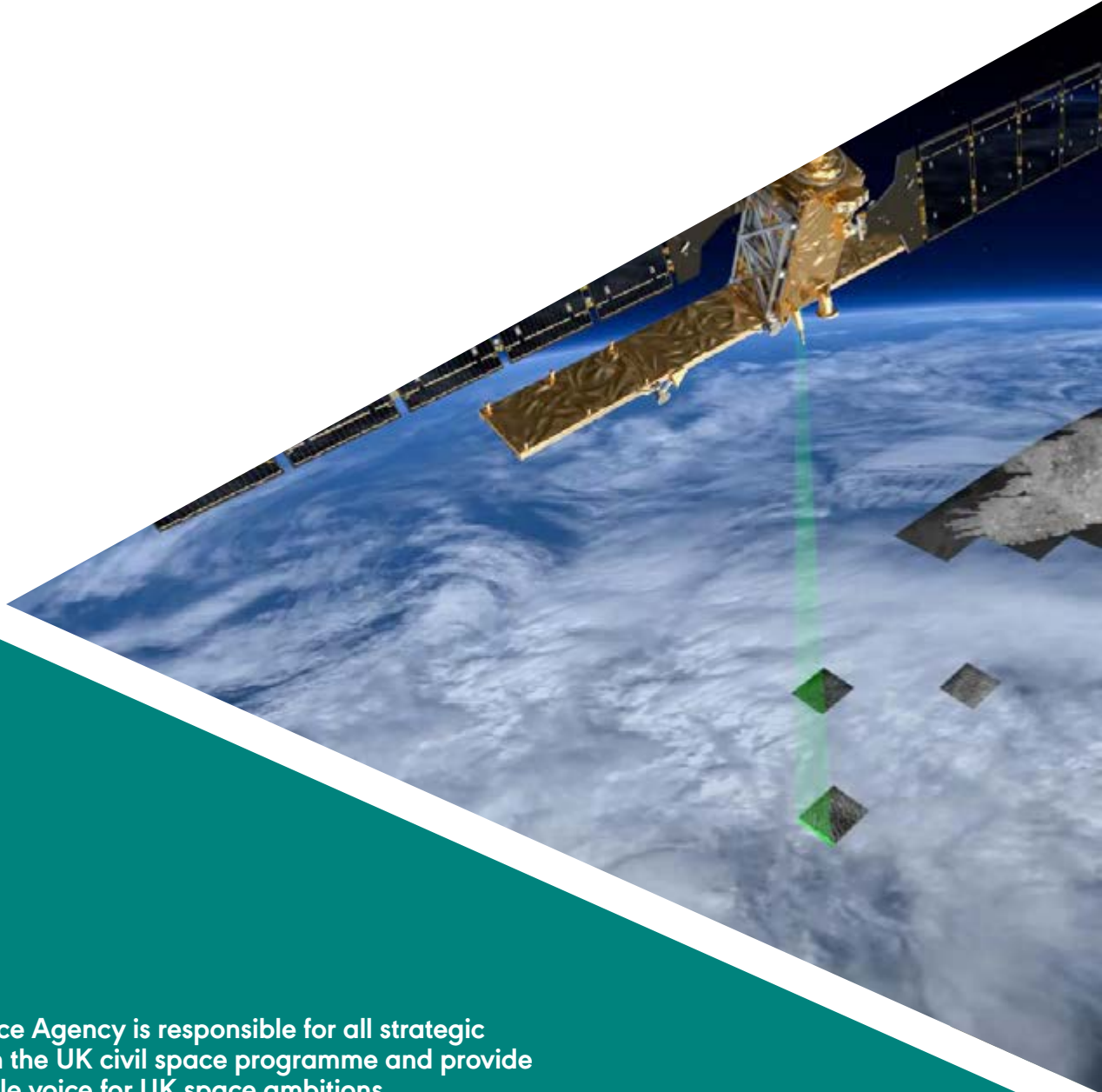
Glossary

COSMO SkyMed	COSMO-SkyMed is a constellation composed of four satellites equipped with Synthetic Aperture Radar operating at X-band
DMC2 satellite	UK-DMC2 is a British Earth-imaging satellite operated by DMC International Imaging (DMCii). It was constructed by Surrey Satellite Technology, based on the SSTL-100 satellite bus and is part of Great Britain's contribution to the Disaster Monitoring Constellation.
FLEGT	The EU Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan aims to reduce illegal logging by strengthening sustainable and legal forest management, improving governance and promoting trade in legally governance and promoting trade in legally produced timber.
GNSS	Global Navigation Satellite Systems (GNSS) are used to pinpoint the geographic location of a user'
HYLAS 2	Launched in 2012, Avanti's HYLAS 2 ka-Band satellite is specifically designed to provide ubiquitous high-speed coverage for customers located in areas lacking terrestrial or GSM coverage.
Joint Altimetry Satellite Oceanography Network (Jason)	Jason is the name of a joint CNES/NASA oceanography mission series with the objective to monitor global ocean circulation, discover the tie between the oceans and atmosphere, improve global climate predictions, and to monitor events such as El Niño conditions and ocean eddies.
KA-band	The term "Ka" stands for K-above, signifying operations within the upper third of the overall K-Band frequency range between 27-40GHz. Ka-Band offers users higher-powered beams with greater throughput capacity for bandwidth-intensive applications such as live streaming video.
Landsat	A commercial high-resolution optical imaging EO satellite system operating from space.
L-band	Frequencies between 1 and 2 GHz are referred to as L-band. L-band antennas are small and lightweight, making them especially suited for tactical and mobile operation. The primary L-band constellation is the Inmarsat I-4 BGAN Network.
Logframes	A logframe is a table that lists your programme activities, short-term outputs, medium-term outcomes, and long-term goals. It is supposed to show the logic of how the activities will lead to the outputs, which in turn lead to the outcomes, and ultimately the goal.

Meteosat	This series of satellites are geostationary meteorological satellites operated by EUMETSAT under the Meteosat Transition Programme (MTP) and the Meteosat Second Generation (MSG) program.
Meteosat SEVIRI	SEVIRI is the scanner carried aboard the Meteosat Second Generation (MSG) satellite.
NCEO	The National Centre for Earth Observation (NCEO) is a distributed NERC centre of over 80 scientists from UK universities and research organisations. NCEO provides the UK's Natural Environment Research Council with national capability in Earth Observation science - monitoring the health of our planet through satellite instruments and more - with world-class capability in interpreting these data.
OTEC	Ocean Thermal Energy Conversion (OTEC) is a marine renewable energy technology that harnesses the solar energy absorbed by the oceans to generate electric power.
PES	Payment for Ecosystem Services (PES) schemes involve payments to the managers of land or other natural resources in exchange for the provision of specified ecosystem services schemes.
RapidEye	ESA's RapidEye constellation of five EO satellites has been in operation since February 2009.
REDD+	United Nations' programme on Reducing Emissions from Deforestation and Forest Degradation (REDD); 'plus' includes afforestation, poverty alleviation, biodiversity conservation and improved forest governance.
SaR	Search and Rescue (SaR) - not to be confused with SAR (Synthetic Aperture Radar - see below) - is the search for, and provision of aid to, people who are in distress or imminent danger.
SAR	Synthetic Aperture Radar (SAR) satellites are a form of radar that is used to create two or three-dimensional images of objects, such as landscapes.
Sentinel satellites in the Copernicus programme	Copernicus is a European Union Programme aimed at developing European information services based on satellite EO and in-situ (non-space) data. The EO satellites which provide the data are exploited by the Copernicus services and are called Sentinels. ESA is developing the new family of missions called Sentinels specifically for the operational needs of the Copernicus programme. Each Sentinel mission is based on a constellation of two satellites to fulfil revisit and coverage requirements, providing robust datasets for Copernicus Services.

Sentinel-1	The European Space Agency's (ESA) Sentinel-1 satellite is a polar-orbiting, all-weather, day-and-night radar imaging mission for land and ocean services. Sentinel-1A was launched on 3 April 2014 and Sentinel-1B on 25 April 2016. Both were taken into orbit on a Soyuz rocket from Europe's spaceport in French Guiana.
Sentinel-2	ESA's Sentinel-2 satellite is a polar-orbiting, multispectral, high-resolution imaging mission for land monitoring to provide, for example, imagery of vegetation, soil and water cover, inland waterways and coastal areas. Sentinel-2 can also deliver information for emergency services. Sentinel-2A was launched on 23 June 2015 and Sentinel-2B followed on 7 March 2017.
Sentinel-3	ESA's Sentinel-3 Sea and Land Surface Temperature Radiometer (SLSTR) is primarily an ocean mission; however, the mission is also able to provide atmospheric and land applications. It provides data continuity for the European Remote Sensing (ERS), Envisat and SPOT satellites. Sentinel-3 makes use of multiple sensing instruments to accomplish its objectives.
SPOT satellites	'Satellite Pour l'Observation de la Terre' (SPOT) is a commercial high-resolution optical imaging EO satellite system operating from space.
Terra/Aqua MODIS	MODIS (or Moderate Resolution Imaging Spectroradiometer) is a key instrument aboard the Terra (EOS AM) and Aqua (EOS PM) satellites. Terra's orbit around the Earth is timed so that it passes from north to south across the equator in the morning (EOS AM), while Aqua passes south to north over the equator in the afternoon (EOS PM). Terra MODIS and Aqua MODIS are viewing the entire Earth's surface every 1 to 2 days, acquiring data in 36 spectral bands, or groups of wavelengths.
Theory of Change	An essential tool in designing and appreciating the complex network of factors which influence project outcomes.
USAID	The United States Agency for International Development (USAID) is the United States' government agency which is primarily responsible for administering civilian foreign aid.





The UK Space Agency is responsible for all strategic decisions on the UK civil space programme and provide a clear, single voice for UK space ambitions.

At the heart of UK efforts to explore and benefit from space, we are responsible for ensuring that the UK retains and grows a strategic capability in space-based systems, technologies, science and applications. We lead the UK's civil space programme in order to win sustainable economic growth, secure new scientific knowledge and provide benefit to all citizens.

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