



Digital Earth AFRICA

Phase I Summary

May 2019



PURPOSE

This document is a summary of Phase I of Digital Earth Africa (DE Africa). Phase I was a scoping exercise initiated in July 2018 to deliver an assessment of the case for further investment in DE Africa. The assessment process included identification of core partners, stakeholder engagement, conducting regional workshops and participating in international events. This input was used to identify the institutional, political, technical, financial and capacity building factors that need to be considered for a successful and sustainable deployment of DE Africa in the long-term.

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Digital Earth Africa

Analysis-ready satellite data for better decisions

BACKGROUND

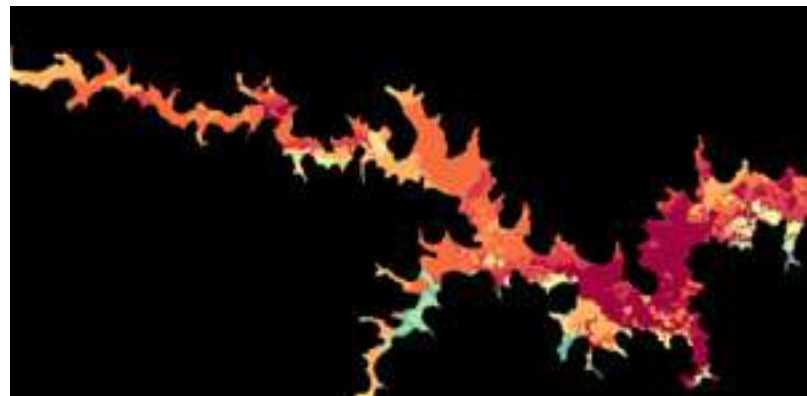
The Sustainable development agenda, as articulated in the Sustainable Development Goals (SDGs), offers new challenges and opportunities as a universal effort aimed at addressing social, economic and environmental issues across all countries by 2030. With 17 goals, 169 targets and over 230 indicators, the Sustainable development agenda is ambitious and requires new approaches for how data can be used to address national development priorities and sustainable development.

Fortunately, we are in an era framed as the 4th Industrial Revolution and within the context of the SDGs a data revolution for sustainable development is allowing for the fusion of technologies to make unprecedented volumes of data available and useful. Billions of people are connected by mobile phones allowing for an unprecedented level of individual information access. When coupled with unlimited processing power, storage capacity and emerging technologies like artificial intelligence, sensors, autonomous vehicles and cloud computing, data is becoming easier and cheaper to collect and infrastructure is allowing new possibilities for analytics, visualization and insights. But with all these breakthroughs, many countries are still facing challenges of data availability and access, quality and usability, disaggregation and timeliness.

As in other parts of the world, countries across Africa face many of these challenges especially as they apply to environmental and social data. Africa is a massive

continent with a rich and diverse environment, and one that is under constant threat, facing new challenges from climate change and environmental degradation. Illegal mining is occurring in many countries and quickly becoming a public priority due to the consequences of land degradation, water quality decline and deforestation. Between the periods of 1990 and 2010, more deforestation occurred in sub-Saharan Africa than in most parts of the world.¹

Food security continues to be an issue with chronic undernourishment increasing to 23% of the population in sub-Saharan Africa, which accounts for 25% of the undernourished population globally.² Globally, Africa also has lowest number of people who gained access to improved drinking water sources (Omisore 2018). Compounding the situation is the lack or absence of high-quality agricultural data, with many countries not having completed an agricultural census in decades.



1 Omisore, Akinlolu. Attaining sustainable development goals in sub-Saharan Africa; The need to address environmental challenges. Environment Development, Vol 25, Mar 2018, pg 138-145.

2 FAO. "The number of people suffering from chronic undernourishment in sub-Saharan Africa has increased." FAO News Article 16 Nov 2017, <http://www.fao.org/news/story/en/item/1062874/icode/>.

As a result, some governments lack the most basic information needed to properly forecast food security or make evidence-based decisions about the quality and quantity of their natural resources. These outline just a few of the problems Africa is facing.

In the era of the data revolution, more and more data are becoming open and easier to access and use. This is particularly true of Earth observation (EO) data. There is a growing demand for the use EO data by countries across Africa to address national development priorities

and other regional frameworks including Agenda 2063 and the Sustainable Development Goals (SDGs).

As a result of open data policies making Landsat and Sentinel data free and open, along with computing power and cloud infrastructure, Open Data Cubes (ODC) are now possible that provide access to analysis ready data (ARD) at continental scales. These EO data can help to address many of the challenges facing Africa and other parts of the world.

Sustainable Development Goal (SDG) Targets and Indicators that can be supported by Earth observations

Target Contribute to progress on the Target, not necessarily the Indicator									Goal	Indicator Direct measure or indirect support to the Indicator					
							1.4	1.5	1 No poverty	1.4.2					
						2.3	2.4	2.c	2 Zero hunger	2.4.1					
					3.3	3.4	3.9	3.d	3 Good health and well-being	3.9.1					
									4 Quality education						
								5.a	5 Gender equality	5.a.1					
		6.1	6.3	6.4	6.5	6.6	6.a	6.b	6 Clean water and sanitation	6.3.1	6.3.2	6.4.2	6.5.1	6.6.1	
					7.2	7.3	7.a	7.b	7 Affordable and clean energy	7.1.1					
								8.4	8 Decent work and economic growth						
					9.1	9.4	9.5	9.a	9 Industry, innovation and infrastructure	9.1.1	9.4.1				
						10.6	10.7	10.a	10 Reduced inequalities						
	11.1	11.3	11.4	11.5	11.6	11.7	11.b	11.c	11 Sustainable cities and communities	11.1.1	11.2.1	11.3.1	11.6.2	11.7.1	
				12.2	12.4	12.8	12.a	12.b	12 Responsible consumption and production	12.a.1					
					13.1	13.2	13.3	13.b	13 Climate action	13.1.1					
		14.1	14.2	14.3	14.4	14.6	14.7	14.a	14 Life below water	14.3.1	14.4.1	14.5.1			
	15.1	15.2	15.3	15.4	15.5	15.7	15.8	15.9	15 Life on land	15.1.1	15.2.1	15.3.1	15.4.1	15.4.2	
								16.8	16 Peace, justice and strong institutions						
17.2	17.3	17.6	17.7	17.8	17.9	17.16	17.17	17.18	17 Partnerships for the goals	17.6.1	17.18.1				

DIGITAL EARTH AFRICA OVERVIEW

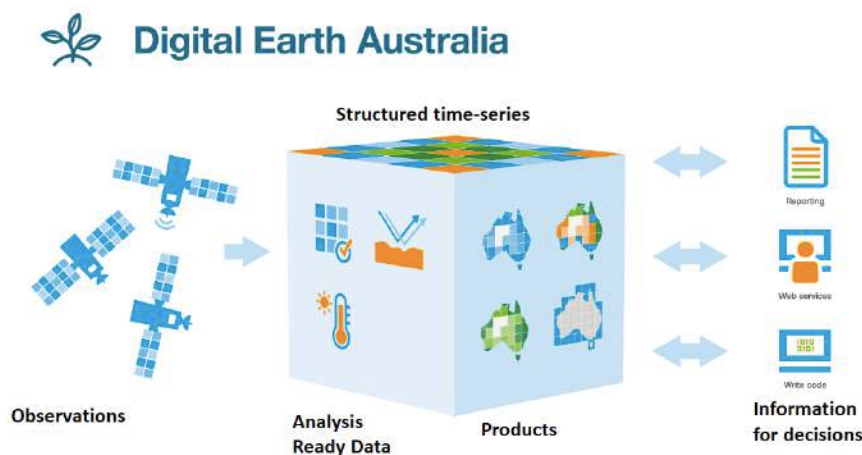
Digital Earth Africa (DE Africa) will provide a routine, reliable and operational service that will enable African nations to track changes across their countries and the continent in unprecedented detail. DE Africa will provide insights on a vast number and wide range of issues, including flooding, droughts, soils, coastal erosion, agriculture, forests and land use and land change, water availability and quality and changes to human settlements. Leveraging technology and services developed in Australia, DE Africa will deliver a continental-scale platform and program that democratizes the capacity to process and analyze satellite data. DE Africa will produce freely available, routine, data products and services analogous to the operation of a weather service.

DE Africa will leverage the achievements and learnings from the Africa Regional Data Cube (ARDC), an initiative spearheaded by the Global Partnership for Sustainable Development Data (GPSDD) as an outcome of its country engagement process (Data Roadmaps for Sustainable Development) and the Committee on Earth Observation Satellites (CEOS). The ARDC focused on developing political buy-in on the importance of data for development, on better connecting information supply and demand, on creating better mechanisms for interoperability and on reducing 'friction' on issues

related to data access - all through a multi-stakeholder approach. The ARDC represents the development of an ODC prototype responsive to the demand on the use of EO data across 5 African countries: Sierra Leone, Senegal, Ghana, Kenya and Tanzania. The ARDC will be fully integrated into DE Africa to provide all African countries the additional functionality and capacity through an operational level service.

The core technology, methods and expertise being applied to DE Africa will come from the Australian government which has implemented the first continental scale, operational data cube – Digital Earth Australia (DE Australia). Developed by Geoscience Australia, DE Australia provides reliable, accessible and regularly updated EO information to Australian governments and industry, allowing for new insights across fields including water, agriculture and urban expansion. Geoscience Australia will bring this experience and expertise and scale it up appropriately for the African continent to meet the needs of its nations.

It is important for DE Africa to be led and owned by African stakeholders, and that it be responsive to the key issues and priorities across Africa. As such, DE Africa will be set up as a major program within an existing



institution in Africa. The host institution will have the necessary administrative, collaborative and convening abilities, growing to support 30-40 staff and visitors over the 3-year establishment period to form the DE Africa Office. In addition, there should be strong alignment in mission and vision, a robust infrastructure that can be utilized and an ability to develop the capacity needed across countries to effectively use EO data in the long-term.

DE Africa will deliver immediate impact stemming from more informed decision making across all sectors, particularly in the water, agriculture and land sectors. DE Africa can also be used to improve reporting in key areas, including the Paris Agreement and the Sustainable development goals. DE Africa will leverage the continuing investment by the Australian Government in creating tools, algorithms and products

for Digital Earth Australia, because it will deliver those same tools and products to the African implementing partners for use across the continent. By lowering the technical and financial barriers for the use of EO data, DE Africa will also empower the African research community to spend more time applying EO data to local challenges and less time on non-productive data preparation activity.

DE Africa is a community activity as part of the Group on Earth Observations (GEO) Work Programme. This means that global input and support can be provided by the international EO community, in particular from AfriGEOSS, which is the regional initiative for GEO across more than half of the countries in Africa. CEOS and GPSDD are both participating organizations in GEO where CEOS already contributes extensively to the GEO Work Programme.

ECONOMIC BENEFITS

DE Africa will drive growth in the economy of Africa by enabling small businesses and industry to more readily access satellite data to innovate and create new products. This will present new opportunities and increase the profitability and productivity of businesses in sectors such as land planning, construction, agriculture and mineral exploration.

Africa already has a rapidly growing tech startup ecosystem with over 400 active tech hubs³ across the continent. One of the goals of DE Africa is to partner with relevant hubs to enable this emerging tech sector to understand the potential power of satellite data for their products and to help them leverage this incredible resource. The data available through DE Africa can be used by this community to develop new

apps and information services for sectors across the entire African economy.

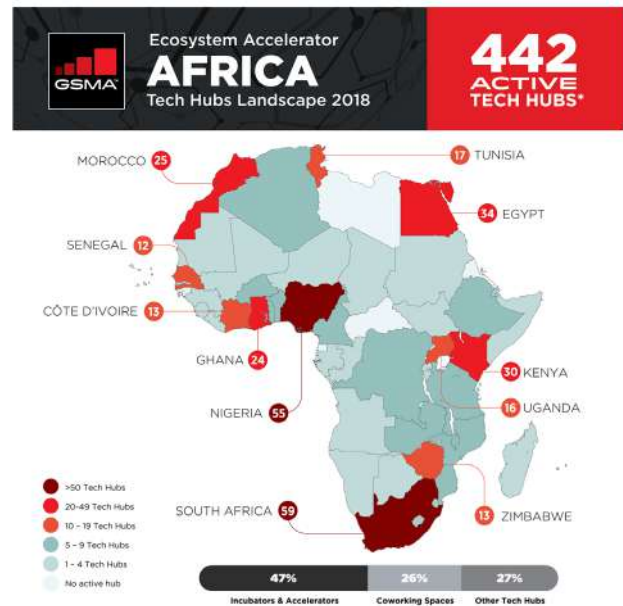
These new apps and information services will in turn drive increased profitability and productivity across the African economy. In fact, global studies have shown that these sorts of information services have the potential to drive significant productivity gains in sectors that represent three quarters of the world's GDP. For example, African farmers will have access to new insights that will help grazers increase the capacity of paddocks and make their farms more viable and sustainable. Similarly, environmental services companies will have access to new data that will enable them to deliver new insights to the mining sector on the environmental impacts of their mines.

3 Bayen, Maxime. "Africa: a look at the 442 active tech hubs of the continent." Mobile for Development Ecosystem Accelerator. 22 March 2018, <https://www.gsma.com/mobilefordevelopment/programme/ecosystem-accelerator/africa-a-look-at-the-442-active-tech-hubs-of-the-continent/>.

A study was recently published⁴ on the potential value of satellite-derived EO within the UK government across nine use cases: agriculture, atmosphere, built environment, coastal, forestry, flooding, maritime, meteorology and transport. Value was defined as relating to operational cost savings, exceptional cost avoidance, better policy decisions and regulation and catalytic benefits (to wider government, economy and society). A few key findings include the following:

- The global satellite-derived EO market is potentially huge but is relatively immature. However, data are improving, infrastructure is advancing, and applications are evolving continuously. The global industry is suggested to be worth 43.7B USD in 2017 and expected to reach 66.1B USD by 2020.
- The total value per year of satellite-derived EO for government applications is estimated to be 943M GBP currently growing to 1.2B GBP in 2020, representing significant value to the UK government and society. Excluding meteorology, the estimated value is 77.5M GBP and 282M GBP per year respectively with use cases on agriculture, hazards, forestry, maritime and transport showing most potential by 2020.
- The study also points to ongoing developments in EO data, application innovation and the emergence of enabling technologies that will improve the storage, processing, analysis and application of EO data (e.g. cloud-based computing, big data analytics, artificial intelligence, machine learning, robotics and automation) that together are

growing the potential for EO to deliver value. This is exactly where solutions like DE Africa add value; DE Africa is the key that will unleash this growing potential.



While the case in UK is likely different than that in countries across Africa, the London Economics report offers evidence on the magnitude of the benefit that can be extrapolated to other countries. Agriculture, flooding, forestry, maritime and transport are all relevant issues in Africa, and this was confirmed in many of the use-cases identified during stakeholder engagement.

4 Sadlier, Greg, R Flytkjaer, F Sabri and R Nicholas. Value of satellite-derived Earth Observation capabilities to the UK Government today and by 2020 - Evidence from nice domestic civil use cases. Final Report, London Economics, July 2018, <https://londoneconomics.co.uk/wp-content/uploads/2018/07/LE-IUK-Value-of-EO-to-UK-Government-FINAL-forWeb.pdf>

STAKEHOLDER OUTREACH AND INSTITUTIONAL HOSTING

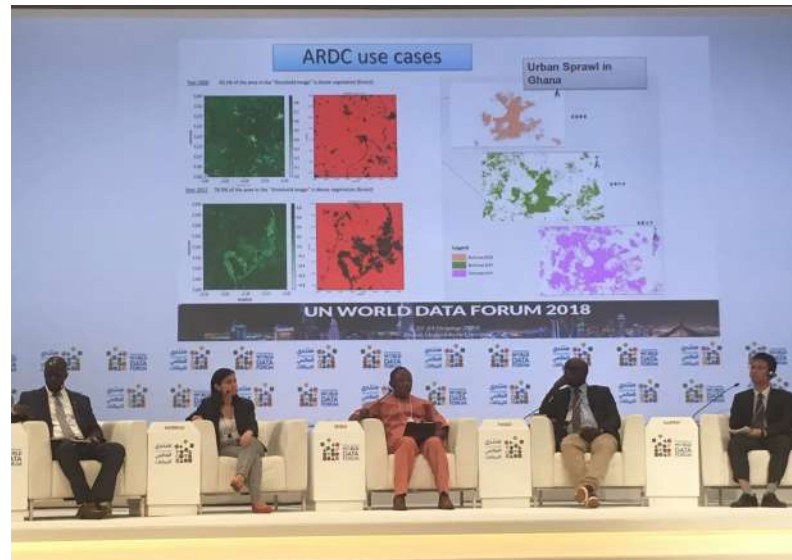
A core focus for Phase I of DE Africa was to conduct a thorough outreach campaign to build awareness of DE Africa and to grow understanding of the core stakeholder base, their specific needs, the activities already being conducted that can be aligned to, and who would be viable candidates for institutionally hosting DE Africa.

A number of events, workshops, presentations and meetings took place between June and December 2018 in Africa and internationally to better understand the landscape, core stakeholders and alignment opportunities for DE Africa. Also, a core objective of Phase I was to also identify a suitable institutional home for DE Africa that adhered to set of key principles including continental-wide mandate, convening power and trust, influence, fiduciary mechanisms, capacity building potential, alignment of missions and alignment to notions of open data and sharing, among others.

Based on an assessment leveraging stakeholder meetings, principles and a set of criteria and questions for potential hosts, it was determined that the United Nations Economic Council for Africa (UNECA) would be best suited to host DE Africa at this stage. Important reasoning behind this finding includes:

- Transparent and known processes within the UN system.
- Programmatic alignment across several activities including Agenda 2030, UN-GGIM and a long history related to programs and activities related to the better use of geospatial data including the development of national spatial data infrastructure programs.
- Linkage to regional development initiatives and policies at the country level including technical capacity building.
- Distribution of regional offices across Africa.

More broadly, there are a number of organizations that have a potential role in DE Africa when considering aspects related to political engagement, technical development and capacity building. A number of other relevant organizations have also been identified and consulted such that a consortium of organizations will likely be brought together in partnership to address various aspects of DE Africa.



TECHNICAL INFRASTRUCTURE

Phase II of DE Africa will be focused on building the infrastructure for the ODC, while also establishing the institution to properly host the program. Much of the deployment will leverage the experience from Digital Earth Australia and the ARDC, each of which has used a different deployment approach to learn from such as how the data are stored and pre-processed, and the infrastructure applied, such as cloud computing or supercomputing facilities.

We know that internet connectivity greatly varies country by country in Africa, and that bandwidth and reliability continue to be issues. Cloud computing makes this less of an issue as the analysis is complete off-premises or “in the cloud”. Internet access is only needed to set the parameters and send the algorithm. As a result, cloud computing will continue to be a likely approach for DE Africa where some hybrid approach may also be considered. A technical roadmap will be developed in early 2019 that will further evaluate best possible solutions for deployment.

Additional issues that will need to be addressed, related to governance and a technical roadmap based on stakeholder outreach include:

- Future demands for data storage, related costs and sustainability of funding for infrastructure costs.
- The ability to transfer data between infrastructures.
- The ability to implement a federated approach by connecting DE Africa to other platforms.
- Considering data sovereignty, for example the integration of national datasets without making them public, but still utilizing data available in DE Africa.
- Questions around user access - completely open or at cost based on sector?
- Consideration of the capacity of the square kilometer array.
- Using DE Africa as an open data infrastructure that initiates a data ecosystem approach by allowing other sectors, including civil society and the private sector, to build business applications on top of the data cube.
- Interoperability - ensuring that the core data infrastructure allows for connecting with other systems to share data and algorithms, while also allowing for applications to be built on top of the infrastructure.

GOVERNANCE

A governance framework will be established to oversee the development and operations of DE Africa as well as the governance, management and use of the data infrastructure. As part of this governance framework, it is important to note that the hosting institution will act as the fiduciary mechanism for DE Africa. Executive direction will be set by the Governing Board, not by the hosting organization.

Phase II of DE Africa will be funded through Geoscience Australia (GA). GA will therefore be responsible to the funding organizations and will retain control as necessary to remain accountable to funding sources.

The governance is anticipated to include a Governing Board that is chaired by Geoscience Australia, a Technical Steering Committee and Stakeholder Community Group as indicated below. It will be important to set targets to ensure regional and gender representation in each body.

Governing Board

The Governing Board will provide strategic guidance, oversight and accountability to ensure successful achievement of the mission and vision of DE Africa. Board membership should reflect the diversity and expertise consistent with the mission of DE Africa

and include members at the highest level within selected organizations. It is recommended that those organizations currently on the Phase I Steering Committee be considered for roles on the newly formed Governing Board and that the Board be kept relatively small to no more than 8-10 members. Each member can also assign an Alternate who can also act as support staff. While specific roles and responsibilities will be defined as part of further articulating the governance framework in 2019, it is expected that some of the key functions will include approving the overall strategy, work plan and budget, monitor achievements, provide guidance to the DE Africa Office and its Head, inform on major policy issues and provide entry points for high-level political engagements and support resource mobilization and outreach and communications.

Technical Steering Committee

The Technical Steering Committee should include world-class subject-matter-experts that can provide guidance on the overall technical program for DE Africa. It is recommended that the membership stay relatively small in the early stages to no more than 10-12

members whose responsibilities may include providing guidance on the work plan, providing insights on the latest innovations, trends and research on the use EO data and contribute to resource mobilization and outreach and communications.

Stakeholder Community Group

Many organizations have been identified that have some level of interaction, expressed interest, or are stakeholders that need further outreach with DE Africa. It is recommended that a community group be established that provides regular updates and offers participants a platform to learn more about DE Africa, how they can get involved, and offer opportunities for networking across the range of stakeholders. It is expected that in time, this community group can evolve into a Community of Practice.

Lastly, the DE Africa Office will consist of a Head and supporting staff. The Head will be endorsed by the Governing Board and direct DE Africa Office staff.

CAPACITY BUILDING

Capacity building and training will be a core component of the DE Africa work program. Based on the ARDC experience and stakeholder outreach, we know that the capacity levels on the use of EO data and cloud computing infrastructure is more limited than, for example, in Australia. At the same time, there is a high-level of expertise within key institutions dispersed across Africa that must be leveraged while also ensuring that capacity building is targeted to the core user base. Therefore, partnerships with regional, technical and research institutions will be critical to advancing the capacity building program across Africa. A significant portion of the 3-year budget for DE Africa should be focused on capacity building.

DE Africa will be focused on developing continent-wide products that respond to the core priorities identified through the governance framework. This will include country level feedback and direction. For example, if access to water was identified as a priority, then the DE Africa Secretariat would focus on developing this product for the continent. A capacity building team within the Secretariat would focus on working with countries to ensure the methods are well understood and, most importantly, work with the countries to understand and interpret the data into policy level and decision-making aspects. Ensuring uptake of data products and impact are priorities for success for DE Africa and therefore a team will be dedicated to this process.

FUNDING MECHANISMS

The intent of DE Africa is to be an operational program that will staff up to the equivalent of 30 people during Phase II over the first 3 years that will focus on building the technical and institutional infrastructure. Phase III will address further issues around sustainability of the program and data ecosystem and innovation approaches across sectors. These phases are not meant to be linear, and it is expected that some parallel activities will take place between each phase leading ultimately to a sustained capability (Phase III).

DE Africa will be a public good, making core satellite and derived data products openly available, at no cost, utilizing the open source Open Data Cube software via Github. In many ways, DE Africa will serve as an interoperable data infrastructure where other sectors may add value to the data and build their own applications for profit, but core data and data products being made available by DE Africa will always be free and open. It is also expected that any partnerships developed with the private sector for providing additional front-ends or gateways to the core data also be done such that the core data remain free and open.

As a result, the initiation of this program through at least the first 5 years will require funding from philanthropy, international organizations and governments. Investment over this initial 5-year period will be largely dependent on external funders



allowing the program to establish and mature, while also allowing capacity building and data products to be applied at the country level all the way through policy and decision-making aspects. The intent is to directly build the value proposition for DE Africa such that it becomes an indispensable tool for decision-makers and creates an ecosystem where business opportunities utilizing EO data also lead to market opportunities and economic growth. As this value is realized, the intent is to gain further investment from countries and institutions based in Africa, while also working with other donor organizations supportive of Phase III where the next level of innovation, capacity and ecosystem development take place.

PROGRAM ALIGNMENT

DE Africa will be a complementary infrastructure in support of other related initiatives and platforms in practice or development for Africa. A key point raised by multiple stakeholders as part of the outreach activities was to highlight the fragmentation across Africa of geospatial and EO data related activities. Numerous platforms, initiatives, projects, etc. are implemented at subnational, national and regional levels, but in many cases coordination and visibility are lacking, and at

times these initiatives are in competition. In addition, many countries are lacking the policy frameworks needed to further enable the sharing and use of geospatial data at the national level. Programs such as AfriGEOSS, UN-GGIM and institutions like UNECA are aiming to fill this gap and provide a mechanism and roadmap for the way forward, for instance through the recently published African Action Plan on Global Geospatial Information Management.

Stakeholders therefore identified an opportunity for DE Africa to better harmonize some of the geospatial and EO data initiatives across Africa, at both the technical and programmatic levels. At the technical level, interoperability will be key. DE Africa can be thought of as a data infrastructure supporting a data ecosystem approach across sectors. DE Africa is not intended to replace other systems or initiatives, but to provide a new capability that demonstrates interoperability and the core principles of open data, encouraging data and algorithms to be shared across systems. Data have no value when at rest, and the more “pipes” that exist to transfer data across systems, the more value is gained through exposure of data to new sets of users who can put it to good use. At the programmatic level partnerships, agreements or other lightweight mechanisms will be developed to ensure synergy and

collaboration on related efforts. The more that can be done aligning these efforts, the greater the potential for additional impact.

Several initiatives have been identified as opportunities for alignment. These are indicative rather than exclusive, and will form a growing list as the DE Africa program further develops:

- ARDC
- GMES for Africa
- African Space Policy and Strategy
- GRID3
- AfriGEOSS
- UN-GGIM for Africa
- Sustainable Development Goals
- Agenda 2063

CALL FOR ACTION

The launch of the ARDC led by the GPSDD very much demonstrated the demand that existed across countries on the use of EO data to address national development priorities in the context of the Data Revolution for Sustainable Development and the 4th Industrial Revolution. During and after the launch, several political leaders provided their support for such an initiative, which only provided further evidence on the need for scaling the approach across Africa.

The Deputy President of Kenya, H.E. William Ruto said his government will use the data cube to underpin the success of food security, a pillar of its ‘Big Four’ priorities alongside manufacturing, universal healthcare, and affordable housing. The data cube will allow the government to understand crop distribution, changing seasons, and use of agricultural land in rural areas; as well as better protect its forests and water towers.

Further, based on meetings that took place in Perth, Australia in November 2018, there was broad support for DE Africa from the Australian Ambassadors to Africa.

As outcomes of the UN-GGIM in Africa Fourth Meeting of the Regional Committee that took place at UNECA in Addis Ababa on October 1-4, 2018, the following statements regarding DE Africa were included in the Resolutions document:

- Noting the impact of Digital Earth Australia in making open source geospatial and Earth observation data analytically ready and freely available to support research, policy and decision-making, and the demand for open data cube technology as demonstrated by the Africa Regional Data Cube being implemented in five countries in East and West Africa,
- Embrace and support the concept of open data cube to facilitate free access to satellite data in order to support the delivery of sustainable development in Africa. We further urge UNECA to evaluate and amplify the benefits of the Africa Regional Data Cube and Digital Earth Africa for its member states, and seek to formalize a

collaborative agreement with Digital Earth Africa to ensure continent-wide awareness and uptake of the products, services and capacity building opportunities to support African nations against their national development priorities, the 2030 Agenda on Sustainable Development Goals and Agenda 2063 - Africa's development roadmap.

In general, there has been widespread support for DE Africa as articulated by core stakeholders

during the outreach activities. While there are some concerns around sustainability of funding, technical infrastructure and capacity building, the value of DE Africa is well-understood and aligned to the mission of many organizations and the needs at the country level. Many support letters have been submitted to provide examples of this support from international, regional and national organizations.



"This technology will help us understand month by month how our land is being used so that we can target interventions aimed at improving our actions against climate change, help smallholder farmers, and secure sustainable food and water for our citizens. Over half of our labor force is made up of agricultural labor. This innovation has the potential to boost our economy, help enhance agricultural production and our efforts to tackle malnutrition in Ghana."

Dr. Mahamudu Bawumia
Vice President of Ghana



"This technology will help us understand month by month how our land is being used so that we can target interventions aimed at improving our actions against climate change, help smallholder farmers, and secure sustainable food and water for our citizens."

H.E. William Ruto,
Deputy President of Kenya



"In the absense of data, it becomes difficult for us to effectively plan. The government has made a deliberate decision to leverage innovation and ICT to make data more available for better planning."

Eugene Owusu,
Special Advisor to the President of Ghana



"With the launch of the Africa Regional Data Cube, we will begin to make the benefits of the data revolution more real and tangible to data communities who have often been left behind. This is a big step towards who we want to be in 2030."

Ambassador Ken Nyauncho Osinde,
Kenya

