

Summary of the GEO Week 2022: 31 October – 4 November 2022

Earth observation (EO) is the collecting of information about the Earth’s atmospheric, oceanic, and terrestrial systems, including changes to these systems over time. EO data provide essential information to policy and decision makers, enabling them to understand the issues they are dealing with and make appropriate and informed decisions. An intergovernmental partnership of more than 100 countries plus the European Commission, the Group on Earth Observations (GEO) promotes extensive use of EO data, information, and knowledge for research, policy, decisions, and action.

Within this context, GEO Week 2022 convened under the theme, “Global Action for Local Impact,” bringing together practitioners to discuss the potential for EO to assist in addressing global challenges. GEO Week included the 18th meeting of the GEO Plenary (GEO-18), which focused on efforts needed to accelerate action in GEO towards environmental and social impact. GEO-18 was heavily focused on the future direction of GEO, with participants engaging in sessions related to the road to GEO post-2025.

GEO Week 2022 also hosted the sixth AfriGEO Symposium, which convened over two days prior to GEO-18. Symposium participants heard from their peers about the transformative power of EO when incorporated into decision-making processes. Many called for a more inclusive GEO, with several pointing to opportunities for private sector financing of EO activities in Africa.

Sessions dedicated to youth also convened prior to the Plenary, giving young people a platform to outline their views, including urging GEO Members to enhance their financing to address challenges in EO data access as it relates to young people. Additionally, an industry track convened, providing an opportunity for industry leaders to engage with GEO Members and others under the banner, “Public-Private Partnerships: A Catalyst for Local Action.”

On Friday, GEO Week participants visited the Songor Ramsar site and a UNESCO Biosphere Reserve Protected Area, a wetland located on Ghana’s eastern coastline. Co-organized by Ernest Acheampong, GEO Secretariat, together with the Wildlife Division of the Forestry Commission of Ghana, GEO Week participants learned about community mangrove restoration and sustainable utilization of wetland resources for economic development in local communities, as well as for biodiversity conservation, including of threatened sea turtles, manatees, and migratory birds.

GEO Week 2022 was held in Accra, Ghana, from 31 October – 4 November 2022.

A Brief History of GEO

GEO is a voluntary partnership consisting of Members, Participating Organizations, and Associates that are working to improve the availability, access, and use of EO for a sustainable planet. GEO promotes open, coordinated, and sustained data sharing and infrastructure for better research, policy making, decisions and action across many disciplines. The GEO community focuses on global priority engagement areas, including the United Nations 2030 Agenda for Sustainable Development, the Paris Agreement on climate change, and the Sendai Framework for Disaster Risk Reduction (DRR). The GEO community has also been building the Global Earth Observation System of Systems (GEOSS). GEO was established during the Third Earth Observation Summit, which took place on 16 February 2005 in Brussels, Belgium. In a resolution, delegations from almost 60 countries endorsed the 2005-2015 GEOSS 10-Year Implementation Plan and established the intergovernmental GEO to implement it.

GEO’s governance structure consists of the Plenary, GEO’s primary decision-making body, that meets annually, the Executive Committee that guides GEO, and the GEO Programme Board, which guides the GEO Work Programme (GWP). The GEO Secretariat, based in Geneva, Switzerland, serves to execute the decisions of GEO’s decision-making body and supports

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the work of the GEO community. The GEO Plenary has been meeting annually since 2005.

GEO Members include the European Commission and any UN Member State that formally endorses the GEO Strategic Plan 2016-2025: Implementing GEOSS. Participating Organizations are intergovernmental, international, and regional organizations with a mandate in EO or related activities who have formally endorsed the GEOSS 10-Year Implementation Plan and been approved by the GEO Plenary. GEO Associates are commercial organizations and national associations of commercial firms, as well as non-governmental, not-for-profit, and civil society organizations with EO-related mandates. GEO Associates must be registered in the territory of a GEO Member and be approved by the GEO Plenary. GEO now consists of 114 Members, 144 Participating Organizations, and 19 Associates.

GEO Week 2021, which took place online, due to the COVID-19 pandemic, from 22-26 November 2021, included GEO-17. It focused on the efforts necessary to accelerate action in GEO towards environmental and social impact. The Plenary considered the results of the Mid-Term Evaluation of GEO with its findings and recommendations underpinning strategies for the evolution of the GWP and engagement activities. The meeting showcased GEO's work, which is delivering science-based, policy-relevant applications, tools, and services that support decision making in GEO's three global priority engagement areas: climate action, DRR, and sustainable development. The GEO Plenary also approved a fourth engagement priority, on "Resilient Cities and Human Settlements" driven by the New Urban Agenda (NUA). Through this engagement priority, GEO will support the use of EO in implementing the NUA and continued work on SDG 11 (sustainable cities and communities).

GEO Week 2022 Report

GEO-18 Plenary

GEO-18 formally opened on Wednesday, 2 November 2022. In opening remarks, GEO Lead Co-Chair Stephen Volz, US, welcomed delegates and participants, noting that GEO-18's theme "Global action for local impact" is anchored around fostering synergies across all GEO activities to enable people to make better choices with EO goods and services.

Kwaku Afriyie, Minister of Environment, Science, Technology, and Innovation, GHANA, welcomed delegates and introduced Mahamudu Bawumia, Vice President, GHANA. Bawumia emphasized that the country is applying the products of Digital Earth Africa (DEA) to monitor land-use change due to illegal mining and developing an interoperable "data ecosystem" that combines EO with socioeconomic data, citizen science, and statistical data for meaningful and impactful sustainable development.

Caryn Dasah, Cameroon Women's Peace Movement, highlighted that those countries most vulnerable to environmental shocks are the least prepared for them, and that people of her generation and region require their governments to use data to build peace and address environmental challenges.



Kwaku Afriyie, Minister of Environment, Science, Technology, and Innovation, Ghana

GEO Co-Chair David Applegate, US, explained the role of US GEO and lauded efforts to coordinate GEO regionally through the AmeriGEO coordination mechanism. He stressed the importance of EO in addressing climate change and biodiversity loss and reiterated strong US support for GEO and its activities.

Via video, GEO Co-Chair Guangjun Zhang, CHINA, shared progress made in his country, including the establishment of the UN Global Geospatial Centre in China and the ChinaGEOSS compendium publication. He highlighted South-South cooperation to provide agricultural monitoring cloud services and technical training.

GEO Co-Chair Joanna Drake, EUROPEAN COMMISSION, stressed that the European Green Deal is a roadmap toward becoming the first carbon-neutral continent by 2050. She highlighted how Copernicus products and services will help in the required energy and digital transition and emphasized that environmental challenges will only be solved through collaboration.

GEO Co-Chair Mmboneni Muofhe, SOUTH AFRICA, stressed EO's relevance in dealing with DRR and climate change impacts. He emphasized the connections between the



Mahamudu Bawumia, Vice President, Ghana



Yana Gevorgyan, Director, GEO Secretariat

environment, health, and the economy, pointing to EO and data sharing as economic opportunities. He drew attention to GEO's post-2025 role in increasing data access worldwide.

Yana Gevorgyan, Director, GEO Secretariat, encouraged GEO Members to: “tap into ambition” for consensus-driven technologies for policymakers to “future-proof” their actions; “reach and aim for outwards consensus” to engage with the most vulnerable communities; and “build a bridge from today to the future” to apply their resources in terms of talents, time, funding, advocacy, and communication.

Approval of the Agenda: Participants adopted the GEO-18 agenda and the GEO-17 draft report (GEO 18/1.5).

New Participating Organizations and Associates: The Secretariat then introduced a new Member State, the Democratic Republic of Congo (DRC), and new Participating Organizations that have joined GEO in 2022: Sociedad Futura, Space for Climate Observatory (SCO), and the West and Central African Research and Education Network (WACREN), for a total of 144 Participating Organizations and 114 Member States. There were no new Associates in 2022.

Operational Services for Africa: Ghanaian Journalist, Atiewin Mbillah-Lawson, moderated the session, stating that Africa faces multiple challenges in its journey to achieve the Sustainable Development Goals (SDGs), and noted these challenges can be addressed by accessible, available, and operational EO. Participants watched a video on EO for coastal monitoring in West Africa, led by DEA.

Thembi Xaba, Managing Director, DEA, underscored that monitoring the coasts of Africa is a service provided uniquely for Africa. She underlined that for DEA, the key is the provision of accessible and readily available data to governments and other stakeholders for implementation of the SDGs. On the impacts of EO for decision making, she pointed to DEA services related to tracking and mapping the availability of water resources, agricultural productivity, and environmental sustainability. Xaba stressed that the most vulnerable are usually left behind in terms of accessing data, underlining that DEA is working to bridge this gap. Sharing her philosophy of bringing science to the people, she said DEA's delivery model works through partnerships with organizations working with communities on the ground.

Samuel Kobina Annim, Government Statistician, GHANA, stated that in 2020, Ghana estimated that 20% of forests were subject to illegal logging and mining activities and underlined the role of EO in addressing this issue. He also noted the role of EO in addressing urban sprawl and stressed the need to integrate statistics with EO to better guide decision making. He underlined the need for crop mapping data to respond to food insecurity and welcomed collaborations to enhance EO for national planning purposes.

Samuel Abu Jinapor, Minister of Lands and Natural Resources, GHANA, highlighted that illegal small-scale mining has had a devastating impact on Ghanaian forest cover, underscoring the importance of reformative mining approaches and stronger enforcement measures. He highlighted that the government is partnering with DEA to access the data required to improve policymaking procedures with respect to illegal mining. Jinapor stressed the need for EO to assist in taking informed decisions on illegal mining and forest protection, noting the importance of balancing between expanding the food basket and protecting the environment. He underlined the importance of data in the distribution of national funding to projects and programmes throughout the continent.

Tidiane Ouattara, African Union Commission (AUC), lauded DEA for their contribution to the continent's ability to access and use data. Pointing to the “Africa We Want” as contained in Agenda 2063, he stressed the need for sustainable socio-economic development grounded in data and information. He welcomed DEA's role in providing data and information for decisionmakers, highlighting that data on storm conditions in the Ocean has assisted Ghanaian fishers in reducing the number of human deaths in open Ocean storms. He noted the importance of engaging with decisionmakers on the African Space Policy and Strategy to align national priorities with regional ones. He stressed the importance of making sure all stakeholders are on the same page, working together, as opposed to in competition with each other, in the provision of services on the continent. For capacity building in the geospatial sphere, he called for a focus on skills development for young people across the continent, underlining the important role of Africa's human capital in this regard. On establishing an enabling



Thembi Xaba, Managing Director, DEA

environment for the integration of EO, he pointed to Global Monitoring for Environment and Security and Africa Service as a partnership using science, technology, and innovation to bring solutions to the most vulnerable on the continent. He called on stakeholders across the region to work together with DEA and others, underlining the importance of a regional approach to development and encouraging regional dialogue to foster synergies at the political, programmatic, and implementation levels.

Berenice Owen-Jones, High Commissioner to Ghana, AUSTRALIA, noted her country had recognized the potential of DEA in improving the lives of people in practical ways through EO to support SDG outcomes. She points to Australia's role in the establishment of the DEA, noting that GEO Science Australia had handed over the DEA to be fully run in Africa by Africans, lauding the role DEA has already played in policymaking for climate change, and for the SDGs. She discussed Digital Earth Australia, noting its role in ensuring productivity for a wide range of sectors. She cited Digital Earth Australia's role in tracking the evolution of coastlines and its work using infrared technology to detect bushfires.

In the ensuing discussion, panelists and participants considered, *inter alia*, the links between coastal monitoring and vulnerability in Africa, the use of information on fire prediction and management, data collection to support the most vulnerable, capacity building and funding needs around EO in Africa, and integrating women and youth into DEA's programmes.

On specific action points, participants called for:

- African countries to deepen engagement and take advantage of available EO data, technologies, and services offered;
- DEA to strengthen partnership at the continental level;
- increased financial and resource investments for DEA to support capacity developments and in-country initiatives;
- building synergies among existing EO initiatives and programmes to achieve wider outreach and deliver maximum impact in Africa; and
- developing Africa's capacities to become resourceful on EO data, technologies, and innovations.

Earth Observations for Nature-Based Solutions: On Wednesday, this session, moderated by Madeeha Bajwa, GEO Secretariat, centered on the role of EO in contributing to nature-based solutions (NbS), climate mitigation and adaptation, and biodiversity conservation. The session took the form of a high-level panel, beginning with a video presentation from Guy Loando Mboyo, Minister of Land Management, DRC, who called for greater technical support from all GEO Members to preserve his country's biodiversity and improve resilience to climate change.

Amb. Tosi Mpanu Mpanu, DRC, and Chair of the Subsidiary Body for Scientific and Technological Advice (SBSTA) under the UN Framework Convention on Climate Change (UNFCCC), mentioned key priorities for his country, including land reform and developing an ecological agricultural production model, among others. On a question regarding the role of local communities and Indigenous Peoples in land reform, Mpanu



Amb. Tosi Mpanu Mpanu, DRC, and UNFCCC SBSTA Chair

stressed the importance of providing scientific knowledge to communities “to monetize the forest resources they have” and to use technological tools to sell data that can enhance knowledge generation.

George Ortsin, UN Development Programme (UNDP), stressed the importance of targeting investments to the “epicenter of critical issues that can have ripple effects” from the local to the regional to the national scales. As an example, he identified the need to predict where threats like illegal mining and forest fires may emerge, their causes, how they can be addressed, and how conditions can be monitored. He noted the outcome of using EO for community resilience is to enhance “landscape assets” built on improved ecosystem services.

Jillian Campbell, Convention on Biological Diversity (CBD), highlighted that EO contributes to measuring ecosystem interactions. For her, challenges remain in the global-national data gap and in efforts to understand and communicate how all ecosystems are interdependent.

In the ensuing panel discussion on how to respond to the global data gap challenge, Lisa-Maria Rebelo, Ramsar Convention, stressed that the information from many critical wetland inventories can be obtained by EO. She highlighted the revival of the GEO Wetlands Initiative at Ramsar Convention's fourteenth meeting of the Conference of the Parties (COP 14).



Moderator Madeeha Bajwa, GEO Secretariat

Barron Joseph Orr, UN Convention to Combat Desertification, addressed the GEO Land Degradation Neutrality Initiative (GEO-LDN) as an integrative value-addition to NbS using EO datasets. François Souldard, Census of Environment, CANADA, highlighted his country's recently launched EO strategy and explained the Ecosystem Accounting of the UN System of Environmental Economic Accounting for measuring the extent and mapping of ecosystems. Lawrence Friedl, National Aeronautics and Space Agency, (NASA), US, highlighted that an ecosystem-extend task team will be proposed at the Committee on EO Satellites plenary later in November.

In the ensuing discussion, panelists highlighted: the need to apply the FAIR (Findability, Accessibility, Interoperable, and Reusability) principles to the NbS data; the need to raise ambition on the minimum data standards for community use; and the importance of partnerships across multilateral environmental agreements, industry, data communities, and other stakeholders. Delegates also raised questions related to, among others: how to incorporate data on urban spaces in NbS actions; the role of NbS in mitigating extreme events; and how GEO can influence data-related climate finance decisions. They also considered how to: embed LDN into national planning processes as a core NbS; promote innovative financing solutions for developing countries; and use nature-based accounting in decision making for developing countries.

As a final takeaway for the panel, Rebelo stressed that protecting wetlands is dependent on knowledge and applying that knowledge, and Souldard stated that efforts should not be duplicated, and those overlapping efforts should be capitalized on. Friedl echoed earlier comments on the need to avoid overselling the abilities of EO, but to give credible hope to partners around risk and the importance of accurate ecosystem accounting.

Road to GEO Post-2025: Katy Matthews, National Oceanic and Atmospheric Administration (NOAA), moderated the session which offered an opportunity for GEO Members to provide feedback on the evolving strategy for GEO's Post-2025 Strategic Mission, as outlined in the Interim Report of the Post-2025



Lisa-Maria Rebelo, Ramsar Convention



Moderator **Katy Matthews**, NOAA

Working Group. A short video was presented identifying what members of the Post-2025 Working Group believed were GEO's value-added benefits.

Melanie Hutchinson, Department for Environment, Food and Rural Affairs (Defra), UK, noted that the Working Group was comprised of 28 members to identify policy trends for the increased use and application of EO and its value added for the private sector, as well as technological trends in machine learning and citizen sensor innovations. She identified key considerations for GEO Member feedback, including, increasing equitable access to EO, strengthening GEO governance, mobilizing new donors, and enhancing communications and advocacy.

Using an interactive online survey tool (Slido.com), participants responded to a series of questions, including what GEO "does best compared to other multilateral bodies" and the types of new activities that will "drive increased investments in GEO programmes and funding to the GEO Trust Fund." On the latter question, MEXICO noted the importance of a strong focus on collaborative projects, KENYA mentioned the role of an aggregated data system for countries, and CANADA stressed the role of marketing GEO goods and services.

On known gaps that GEO is best positioned to bridge, participants both online and in-person mentioned, among others, *in situ* data standards, time-series analytics, and citizen observation. On what inclusiveness and equity would look like in GEO's future governance model, participants mentioned, *inter alia*, greater consideration of Indigenous Peoples' voices, knowledge sharing, and free and open data access. On new partnerships and investments needed to drive scalability, participants stressed the role of public-private partnerships (PPPs) and open-source communities to operationalizing the work of GEO.

SWITZERLAND, supported by CANADA, highlighted three points for the post-2025 GEO: focusing on a limited number of priority areas of high strategic importance, which are closely aligned with the needs of stakeholder governments; ensuring government retains "oversight and control" over private-sector partnerships to mobilize innovative financing; and identifying GEO's target audience for the greatest impact, urging Members

to better integrate GEO's work in existing technical reports, such as UNEP's Global Environmental Outlook, rather than a proposed annual GEO landmark on the state of EO.

Some members of the Working Group then gave their final takeaway messages. Yuqi Bai, Tsinghua University, CHINA, stressed the need to determine mechanisms for innovative financing for EO. Humbulani Mudau, Department of Science and Innovation, SOUTH AFRICA, mentioned strengthening coordination across GEO processes. Angelica Gutierrez, NOAA, US, and Amadou Moctar Dièye, Centre de Suivi Écologique, SENEGAL, urged greater connectivity to national GEOs. Alejandro José Román Molinas, Paraguayan Space Agency, stressed collaboration and knowledge sharing for emerging economies.

Future-proofing National Adaptation Plans: On Thursday, Moderator Atiewin Mbillah-Lawson, Ghanaian Journalist, highlighted the implications of climate impacts on the agricultural sector in Africa and elsewhere. She noted the need to unlock finance for integrating EO into national adaptation plans (NAPs).

In a keynote address, Paul Desanker, Manager of the Adaptation Programme, UNFCCC Secretariat, emphasized that the quest for getting big data on climate change into the hands of decision makers from the developing world has been ongoing for 25 years, noting several innovations over time, including the production of CD-ROMs containing EO for wide distribution in the 1990s. He shared that adaptation is a progressive, learn-by-doing journey, underscoring that it is a global responsibility which connects to regional, national, and local actions. He stressed the need for more EO data to directly support countries that are now facing extreme shocks more frequently. Highlighting adaptation milestones under the UNFCCC, he pointed to the 2015 Paris Agreement which ramped up adaptation goals already being addressed by the Framework Convention. He pointed to various adaptation initiatives, including: Open NAPs for direct country support, technical guidance and support through the LDC Expert Group, the UN Secretary-General's Adaptation Pipeline Accelerator to support the development of NAPs and adaptation project proposals, and a UN-wide mobilization in support of NAPs. He called on the EO community to support the global goal on adaptation and in identifying priorities and underlined the need for more EO capacity in finding solutions to loss and damage



Paul Desanker, Manager of the Adaptation Programme, UNFCCC Secretariat

through the Santiago Network. He underscored the importance of: EO for pragmatic aspects, such as support to subsistence farmers; and crop monitors as essential and practical tools for adaptation.

Esther Makabe, GEO Global Agricultural Monitoring Initiative (GEOGLAM), presented crop monitoring for early warning systems, sharing the experience of the national Uganda crop monitor, which gave three months of early warning of crops likely to fail due to drought in 2019. She highlighted the importance of guidelines to support NAPs with EO and announced the launch of the GEO Supplement to the UNFCCC NAP Technical Guidelines. She regretted the lack of funding to scale-up projects.

Samuel Joseph Gama, Principal Mitigation Officer, MALAWI, presented a community-based flood early warning system for effective disaster preparedness and recovery. He shared its performance during Cyclone Ana in early 2022 in Southern Malawi and drew attention to the economic impact reduction achieved through this system.

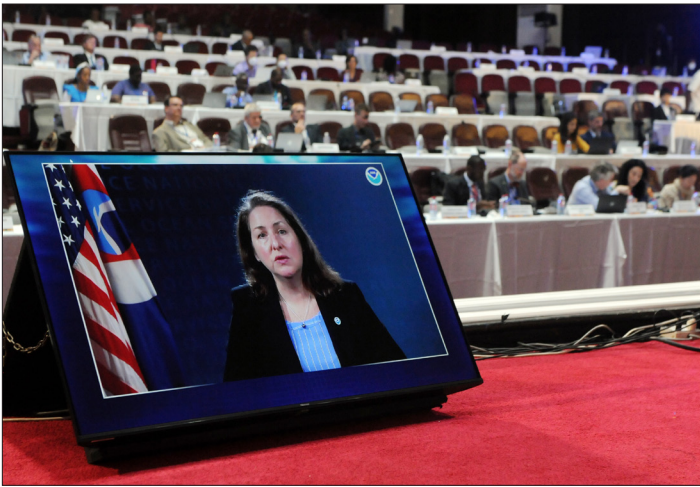
In the ensuing discussion, panelists responded to questions relating to: free and open *in situ* data use, multi-scalar capacity building, and ways that GEO can facilitate collaboration for long-range prediction modelling influencing NAPs to respond to crises like droughts and crop failure. ALGERIA questioned the accuracy of flood prediction data, with Gama noting the “near 100% accuracy” of GEO Global Water Sustainability (GEOGLoWS) data for DRR. On a question posed by the NETHERLANDS on greater private sector involvement, Makabe stressed the need to “better define and clarify the value proposition for the private sector and for GEO to work more efficiently” in providing EO data. On future challenges and expectations, Desanker underscored the “digital divide” and ensuring assistance in distilling large quantities of data into “useable information.” Makabe underlined the challenge of ensuring interoperability that creates better data handling measures and standards to improve data efficiency.

On specific action points from the session, delegates agreed that:

- GEOGLAM will continue capacity development to design protocols for funding, while GEOGLoWS will develop supplementary technical guidance on NAPs;
- seed funding will be raised to ramp up EO-based monitoring systems for NAP implementation; and



Esther Makabe, GEOGLAM



Nicole LeBoeuf, NOAA, US, addresses participants via a video message

- country delegations will raise GEO profile within the UNFCCC in relation to NAP support as well as on early warning systems.

Collective Action on Oceans, Climate and Biodiversity:

Moderator Mbillah-Lawson, Ghanaian Journalist, introduced the session noting that more than 80% of the Ocean has never been mapped, lamenting the dearth of funding for ocean science.

In a keynote address, Nicole LeBoeuf, NOAA, US, noted over 40% of the global population lives in coastal areas, pointing to the need for more EO to monitor them. She stressed that NOAA is looking to Ocean data to fuel climate financing, sharing that the US' New Blue Economy Agenda will contribute to the country's climate resilience and adaptation goals. She highlighted the importance of autonomous Ocean sensors which, she noted, will continue to be essential in planning for hurricane responses in the Americas. She underlined that marine science must be included in discussions on NbS under both climate and biodiversity negotiations. She said UNFCCC COP 27 will be an implementation COP, pointing to the need for action in, among others, reducing shipping emissions, noting co-benefits for reducing underwater noise, and marine ecosystem conservation. She stressed that Ocean data will be key to implement solutions advantageous for both climate and biodiversity and highlighted the need for more granular data collection led by coastal communities.

Amb. Tosi Mpanu-Mpanu, DRC, and UNFCCC SBSTA Chair, noted the need for a new systems approach to address threats to the Earth's climate, biodiversity, and Ocean ecosystem. He highlighted the role of EO in this regard, mentioning the need for free and unrestricted access to all climate-related observations. Mpanu-Mpanu underlined that a global coordinated approach is necessary to address climate threats. He hoped for a decision on the fundamental place of EO in climate-related decision making. On the need for a common monitoring framework for reporting under the UNFCCC and the CBD, he noted that this would assist in generating synergies and opening doors to increased financing.

Presenting the outcomes of the GEO Blue Planet Symposium, Nikelene Mclean, NOAA, US, explained that GEO BLUE



Nikelene Mclean, NOAA, US

Planet acts on stakeholder engagement, capacity development, cooperation, and co-design to deliver actionable activities. She said the Symposium, which convened in October 2022 in Accra, featured discussions on fisheries, coastal hazards, and Ocean observations. She highlighted the need for: exposing youth to the prospects of Ocean science, particularly in Africa; more support for local and regional Ocean observation projects; an information hub for fisher folk to prevent storm-related deaths; support for the guidance on NAPs with an emphasis on coastal adaptation; and increased land-to-sea litter monitoring using EO.

Panelists, including Isa Elegbede, Lagos State University, and Toste Tanhua, Global Ocean Observing System, expressed the need for reliable and high-quality fully open access data, strengthening Ocean observation capacity, and fostering NbS. Tanhua also stressed the importance of having one voice with a powerful message. Others echoed challenges mentioned by panelists included open data access, interoperability, strong networks, and Ocean observation collaboration. In final remarks, panelists emphasized: the unique position of GEO to provide insights and ways forward; GEO Blue Planet's role in achieving integration; and the importance of the GEO data sharing and data management policy.

Finally, delegates agreed, as action points, to:

- build partnerships for technical support, including for GEO Blue Planet to continue work on NAP guidance for coastal zones;
- strengthening advocacy by streamlining messaging and to have a GEO Member advocate for GEO at the UNFCCC and the CBD; and
- tap into multiple funding sources, including the private sector.

The Way Ahead: Plenary Business and Decisions: Stephen Volz, NOAA, US, and GEO Lead Co-Chair, moderated the session, emphasizing the importance of: taking stock of where GEO's future lies; stepping back from the "I own this data project or system" mentality; and reflecting on the GEO community's sense of duty to support the policy community.

Neil Sims, Commonwealth Scientific and Industrial Research Organization (CSIRO), AUSTRALIA, reported on the final



Neil Sims, Commonwealth Scientific and Industrial Research Organization, Australia

report of the Expert Advisory Group on the GEOSS to review whether the GEOSS continues to be relevant to the GEO Mission. In presenting results of a survey of GEOSS users and through national and regional consultations, he noted that the lack of tailored filter and search tools and user-friendliness remain limiting factors of the GEOSS platform. He presented three options for advancing GEOSS going forward, including: discontinuing investment; pivoting investments from the current GEOSS platform towards end-user needs, including to better support low to middle-income countries; and continuing to invest in the GEO-hosted GEOSS platform and enhance its functionality, including by improving search functionality and integration with the GEO Knowledge Hub. He presented some key recommendations and next steps including to consider improving *in situ* data support and to coordinate an in-depth cost-benefit analysis of the options.

In the ensuing discussion, FINLAND, supported by the UK, SWITZERLAND, and GERMANY, noted that “GEO does not own GEOSS,” stressing the importance of further discussion on the motivations underlying the GEOSS Platform. GHANA highlighted the need to ensure GEOSS and other similar systems feed into the GEO Knowledge Hub. GREECE urged greater support for the regional character of the GEOSS Platform. The EUROPEAN COMMISSION reminded Members that GEOSS should be tailored to the EO community. She echoed comments by COSTA RICA and the UK on the need to further engage with national and regional GEO stakeholders to refine the options further, and to define the technical and financial implications of each, stressing there could be different combinations of options that are not mutually exclusive. Moderator Volz, together with Sims, agreed on the need for additional engagement, with Volz underscoring that in relation to the overall GEO Mission, “we never walk away from Ministerial decisions.”

GEO Work Programme: Evangelos Gerasopoulos, Co-Chair of the GEO Programme Board, presented the process towards drafting the GEO Work Programme for 2023–2025. He informed delegates that the Work Programme would also launch post-2025 incubators to tackle important domains including on health and NbS. He noted that the number of programmes had been reduced, due to the integration of activities, and announced the

GEO-LDN as a new GEO Flagship and the EO for DDR as a new Initiative. He expressed gratitude to the donors supporting the implementation of activities, noting the need to encourage more states and non-profit organizations to provide activity funding. He noted this new Work Programme ushers in a period of transition, which comes with both challenges and opportunities.

In the ensuing discussion, GERMANY congratulated the GEO-LDN for becoming a new GEO Flagship, noting it benefited from EUR 6.2 million of German funding, and calling for other Members to provide additional funding to sustain the it. GHANA and FRANCE also congratulated the GEO-LDN steering committee and the UNCCD for their work on the GEO-LDN Initiative. FRANCE queried the process for new activities joining the Programme.

FINLAND underlined the goal that the Programme continues to provide operational services. CHINA welcomed the new Work Programme, noting the number of Chinese experts supporting activities, and called on more participation from developing countries.

The UNCCD congratulated all the organizations involved in the work towards launching the GEO-LDN Flagship, underlining that the UNCCD is ready to join this work in line with addressing all 17 SDGs. SENEGAL expressed appreciation for the Work Programme, acknowledging that this is an opportunity for the world to understand what GEO offers, and looked forward to discussions on the Post-2025 Strategic Plan. Delegates then approved the Work Programme 2023–2025.

2021 Financial Statements and Audit Report: Brian Cover, Finance Division, World Meteorological Organization (WMO), virtually presented the 2021 Financial Statements and Audit Report. He reminded Members that WMO administers the GEO Trust Fund and lauded the GEO’s current strong financial position.

2023 GEO Secretariat Trust Fund Budget and Pledges: Lawrence Friedl, NASA, US, and GEO Budget Working Group Co-Chair, presented the 2023 GEO Secretariat Trust Fund Budget and Pledges, noting that the total amount of CHF 8,870,000 (cash and in-kind) operational budget will support GEO work and activities in 2023.



GEO Lead Co-Chair **Stephen Volz**, US

Executive Committee and Programme Board Members for 2023: Yana Gevorgyan, Director, GEO Secretariat, presented the Executive Committee Members for 2023, including, Nigeria, Senegal, South Africa, Costa Rica, Peru, US, Australia, Japan, China, Republic of Korea, Spain, France, and Italy. Wenbo Chu, GEO Secretariat, presented the Programme Board Members for 2023, noting that eight nominations had been received for eight vacancies.

Review of GEO-18 Plenary: Erika Alex, GEO Secretariat, gave a brief overview of GEO-18, including session outcomes, consensus, and action points. Gevorgyan stressed that Members may send comments and official delegation position responses on the pending issues to the GEO Secretariat until 25 November 2022.

Highlights from the Youth and Industry Tracks: Mary Namukose, Women in GIS-Uganda, and Patricia Cummins, Esri, offered highlights from the Youth and Industry Tracks, respectively. Namukose urged GEO Members to enhance their financing to address challenges in EO data access for youth, including by supporting the private sector and research and academic institutions. Cummins also stressed that successful PPPs are built along trust and relationships and urged greater integration of conversations among the GEO community, rather than through siloed “tracks” that separate industry from youth and others.

GEO Excellence Awards: GEO Secretariat Director Gevorgyan presented the GEO Individual Excellence Awards together with Jean Dusart, European Commission, and Phoebe Oduor, Regional Centre for Mapping of Resources for Development (RCMRD). Winners included:

- Lynwill Garth Martin, for promoting mercury monitoring activities through the GEO Flagship Global Observation for Mercury (GOS4M);

- Christina Justice, for building the GEOGLAM Crop Monitor for Early Warning;
- Neil Sims, for his excellence in leadership within GEO both for the GEO-LDN Flagship and in the GEO Expert Advisory Panel; and
- Michael Souffrant, for his work with GEOGloWS global streamflow services.

GEO SDGs Award: Lawrence Friedl, NASA, US, together with Maryam Rabiee, UN Sustainable Development Solutions Network (SDSN), presented the GEO SDG Awards under six categories. Winners included:

- Reforestamos Mexico (for GEO Member Country);
- UNOSAT (for GEO Participating Organization);
- Digital Earth Africa (for GEO Work Programme Activity);
- KTH Royal, Division of Geoinformatics (for Academia);
- EOS Data Analytics (for Commercial Sector); and
- UNDP and Costa Rica Ministry of Environment (for Collaboration).

Date and Venue of GEO-19 and 2023 Ministerial Summit: GEO Co-Chair Mmboneni Muofhe, Deputy Director General, Department of Science and Technology, SOUTH AFRICA, announced that the 2023 Ministerial Summit would be held in Cape Town, South Africa, from 4-8 December 2023. GEO Secretariat Director Gevorgyan then announced that the deadline for nominations of the Ministerial Working Group had been extended to 25 November 2022, calling for delegations to please make their nominations for Working Group members.

Closing Plenary: Kwaku Afriyie, Minister of Environment, Science, Technology and Innovation, GHANA, offered closing remarks. He stressed that “business as usual cannot be enough,” highlighting the need to strengthen institutional capacities in developing countries to transform datasets into actionable information for decision makers. Afriyie announced that the



Group photo following the Awards Ceremony

country would establish a national GEO. He lauded Germany's financial support in combating LDN and emphasized Ghana's commitment to position itself to define innovative ways of using information technology and EO goods and services to achieve sustainable development.

GEO Co-Chair Applegate, NOAA, US, underlined the importance of EO to support the SDGs and decision making for humanity and the planet, noting the issues that need to be addressed are complex but can be overcome if "we work together." He said that the Plenary was key to setting the future stage for GEO and looked forward to a vibrant vision for GEO's mission.

Via video, Guangjun Zhang, Vice Minister of Science and Technology, CHINA, noted that GEO-18 had laid a solid foundation for the future of the process. He called on the GEO community to build on previous achievements and promote coordinated efforts to support EO in decision-making processing. He urged support for developing countries in their capacity needs and noted that as GEO Co-Chair, China will share best practices on EO to address global challenges.

Joanna Drake, EUROPEAN COMMISSION, acknowledged the progress made on thematic areas within the GEO community and called for a renewed commitment towards achievement of the Paris Agreement and the SDGs.

Mmboneni Muofhe, SOUTH AFRICA, thanked the government of Ghana for hosting an excellent GEO Week. He expressed appreciation for the level of discussion and engagement throughout the conference and highlighted that even though challenges exist that need to be addressed on the continent, there is still a "sense that things are going in the right direction."

Yana Gevorgyan thanked the host government and the entire GEO community for the very productive week. She invited all GEO Members to "hop on the bus" towards a new direction for GEO and welcomed delegates to the 2023 Ministerial Summit in Cape Town in December 2023. GEO Lead Co-Chair Volz closed the GEO-18 Plenary at 6:05 pm.



Bird's eye view of GEO-18 during final remarks by **Yana Gevorgyan**, Director, GEO Secretariat



Yana Gevorgyan, Director, GEO Secretariat, during the opening of the AfriGEO Symposium

AfriGEO Symposium

The sixth AfriGEO Symposium opened on Monday, 31 October 2022, under the theme "harnessing EO towards resilient and sustainable systems, communities, and resources."

Opening the session, moderator Ernest Acheampong, GEO Secretariat, underlined that the Symposium was an opportunity to develop regional capabilities to achieve "Agenda 2063: The Africa We Want."

Robinson Mugo, RCMRD, highlighted inter-sectoral collaborations such as the GEOGLAM and GEOGLWS.

Yana Gevorgyan, Director, GEO Secretariat, underlined EO information can help unlock climate finance. She called on delegates to boldly voice their needs about what the future GEO should incorporate.

Tidiane Outtara, AUC, highlighted that EO should be a guiding light for all African development planning processes.

Mmboneni Muofhe, Department of Science and Technology, SOUTH AFRICA, welcomed individual Members' initiatives, noting the potential of harnessing EO to address emerging threats.

Underlining the need to address potable water resources, Elvis Asare-Bediako, Vice Chancellor of the University Energy and Natural Resources, noted satellite technology can assess water resources, and monitor pollution and radiation levels.

Cynthia Asare Bediako, Chief Director, Ministry of Environment, Science, Technology, and Innovation, GHANA, shared that the country is in the process of developing their space policy, and the creation of a Ghana Space Science Authority.

Building Resilient and Sustainable Systems: During this session, participants focused on sustainable systems to enhance regional and national capacities, considering programmes created to address development challenges and/or broker access to regional data and mechanisms which strengthen dialogue and collaboration.

Davis Adieno, Global Partnership for Sustainable Development Data (GPSDD), moderated the session, noting the importance of EO in forecasting and addressing drought in vulnerable countries. Dan Irwin, Bako Mamane, and Robinson Mugo, SERVIR, presented on connecting space to villages in Africa. Irwin introduced SERVIR as a tool to use EO to



Robinson Mugo, SERVIR

address critical water issues and related disasters, food security, land cover and land-use change, and climate change. Mamane highlighted SERVIR West Africa, working in six countries on, *inter alia*, desert locusts risk mapping, crop-type mapping exercise, and flash flood mapping exercise. Mugo highlighted, among others, a borehole water monitoring forecast in arid and semi-arid areas in Eastern Africa to ensure water security.

Zviko Mudimu, DEA, underlined that DEA could unlock USD 2.3 billion per year for African industry. Lulekwa Makapela, South Africa Group on Earth Observation (SA-GEO), highlighted that SA-GEO's goal is to implement the national space science and technology strategy in line with global and AfriGEO activities.

On resilience and sustainable systems, Tidiane Outtara, AUC, highlighted the need to connect the dots between national and regional EO initiatives to strengthen the EO system as a whole. Henry Bulley, Borough of Manhattan Community College, shared that Africans in the diaspora are working to collaborate with academia on the continent to create a database of diaspora and African geospatial scientists for research, teaching, resource management, planning, and policymaking.

Building Resilient and Sustainable Communities:

Moderated by Angélica Gutiérrez, AmeriGEO, this session



Tidiane Outtara, AUC

addressed measures that have been taken using EO to empower communities to be more resilient to climate change impacts.

Calvince Wara, RCMRD, drew attention to the establishment of a community-based early warning system, which triggers flood warning alarms to downstream communities through telemetric sensor technology. Benson Kenduiwo, RCMRD, noted that index insurance uses EO to project agricultural production, creating pathways to protect farmers from extreme losses and allowing governments to invest in products that accelerate and protect overall economic growth.

Galaletsang Keebine, South African Environmental Observation Network, presented on the open access data platform under the South African Risk and Vulnerability Atlas. He highlighted its objective of equipping decision makers with spatial and non-spatial data on the global change impact and risk. Catherine Nabukulu, University of Twente, presented her research on a satellite-based analysis of tropical cyclone rainfall for improved flood hazard assessment, focusing on tropical cyclone precipitation in the Caribbean and Madagascar.

Antar Jutla, University of Florida, presented a predictive intelligence system for cholera using EO, noting the potential for satellite remote sensing data in predicting health concerns. He shared a model which predicts spatial risk of cholera outbreaks after floods. He noted the potential for EO to flatten the disease curve towards less mortality and incidents of outbreaks. Highlighting a Vibrio Prediction Hub, he explained that these risks are shared with decision makers to act on potential risks. He underlined the need to act rather than react, calling for anticipatory decision making.

Speaking on promoting citizen science through the Volunteered Geographic Information platform in environmental resource assessments, Henry Bulley, Borough of Manhattan Community College, addressed community flood mapping in Kampala, Uganda.

Sustainable Urban Development: Moderated by Pauline Okeyo, Esri, this session considered the EO tools available for mapping urban growth, planning urban development and supporting provision, and access to resources.

Speaking on the role of open mapping for sustainable urban development, David Luswata, Open Mapping Hub Eastern and Southern Africa, highlighted the potential for open data systems and citizen-generated data for addressing urban challenges. He shared that OpenStreetMap creates free editable maps that can be used in emergency response, and in urban planning, including public health programmes, climate resilience projects, and early warning systems.

Adeniran Akanni, Lagos State Ministry of Environment and Water Resources, NIGERIA, presented an ecological monitoring framework to make cities inclusive, safe, resilient, and sustainable through an urban nature index.

Armél Nzué Mba, Agence Gabonaise d'Etude et d'Observation spatiales (AGEOS), focused on EO in hazards monitoring. He noted that AGEOS works to improve risk mapping across the country, including through setting up early warning systems.

Naledzani Mudau, South African National Space Agency, presented the EO ToolKit for Sustainable Cities and Human Settlements. She noted that this tool is used by international collaborators, also working with UN-Habitat, to implement SDG 11 (sustainable cities and communities), Africa Agenda 2063, and other goals at the national, municipal, and local levels.

Participating virtually, Nasreddine Belabid, Algerian Space Agency, focused on flood mapping in Algeria. He presented flood extension maps and explained that the 296 risk flood maps developed to inform municipal planning were based on water levels and velocity.

Emma Knowland and Carl Malings, NASA, US, virtually presented on air quality data with a focus on Senegal. Knowland underlined that air pollution can reduce crop yields and noted the limitations of satellite imagery and simulation models. She highlighted the GEOS Composition Forecast System, which gives high quality air quality data by combining global and local data sources into a data fusion system to aid in air quality policy decision making. Malings demonstrated the data fusion system using an air quality case study in Dakar, Senegal.

Road to GEO Post-2025: Participants in this session discussed the roadmap to a post-2025 strategy for GEO. Opening the session, moderator Anastasia Wahome, RCMRD, noted the need for GEO Members to reflect on the institution's trajectory. She stressed that the decision on the post-2025 GEO will be made by GEO Members, not the leadership, calling for members of AfriGEO to share their priorities. She noted AfriGEO would need to contribute to the work of the Post-2025 GEO Working Group.

Humbulani Mudau, Chief Director for Space Science and Technology, Department Science and Innovation, SOUTH AFRICA, and a member of the Post-2025 GEO Working Group, noted the GEO Executive Committee mandated the Working Group to engage with Members to harness inputs to shape the future strategy of GEO. He said that at the GEO Ministerial Conference in 2023, a decision will be endorsed on the future of GEO, noting a Ministerial Working Group would be established to prepare for the GEO Ministerial Conference in Cape Town. He underlined policy trends, including the widening digital gap between developed and developing countries, and the importance of including the private sector in the work of GEO.

He highlighted the need to concretize GEO's role in the fourth industrial revolution. Mudau stressed the need for a GEO that is: a catalyst; fit-for-purpose; and leaves no one behind.

Amos Kabo-bah, University of Energy and Natural Resources (UENR), underscored the need for continuity in the GEO process and that GEO should be a catalyst for a better world, stressing this is the time for Africa to take the lead in making a change in understanding the potential for EO in global problem solving. He urged breaking down silos within the GEO landscape and crafting innovative financing systems to further EO on the continent.

In the ensuing interactive discussion, participants called for an inclusive GEO, and sustainable financing, and engaging on the Slido platform to respond to questions regarding GEO's past, current, and future priorities.

Enhancing Resilience and Sustainability of Resources: Moderated by Anastasia Wahome, RCMRD, this session addressed EO contributions to better manage, measure, and monitor natural resources to guarantee the protection for future generations.

Lynwill Garth Martin, GOS4M, introduced GOS4M as a GEO Flagship, which supports the Minamata Convention on Mercury by monitoring mercury levels, and called for a coordinated African mercury monitoring network to enhance data collection on mercury.

Francis Manfoumbi, AGEOS, spoke on forest mapping in Gabon, and shared results of forest monitoring exercises which reveal forest losses due to urbanization, logging, mining, and land-use change to agriculture.

Webster Gumindoga, University of Zimbabwe, presented on geospatial methods for national wetlands delineation, noting the lack of knowledge on the spatial extent of wetlands in the country precludes their intentional protection. He described the approach to wetland delineation, including satellite and *in situ* approaches which have yielded a comprehensive wetlands map that feeds into national planning processes.

Adama Sarr, Centre de Suivi Écologique, SENEGAL, spoke on connecting West African crop mapping through geospatial data. He highlighted the importance of a service planning approach to food security in the Sahel region, supported by geospatial data, further strengthened by stakeholder consultation



L-R: **Amos Kabo-bah**, UENR; **Humbulani Mudau**, Chief Director for Space Science and Technology, Department Science and Innovation, South Africa; and moderator **Anastasia Wahome**, RCMRD



Participants during the AfriGEO Symposium

and participation, and establishing a service-based or needs-based design before crop mapping in order to create a community of practice.

Loïc Kenmou, Observatoire des Forêts d’Afrique Centrale (OFAC), shared that the role of OFAC is to ensure the permanent availability of information on forest ecosystems, combining field and geospatial data collection methods. Noting OFAC is an information broker for data used by policymakers, he shared OFAC’s open access web analytical mapping platform, which includes new regional forest-type maps for Central Africa.

Speaking on using remote sensing to detect irrigation practices in the Qhumanco farms, Ndilisa Didiza, SA-GEO, and Founder, Kgothatso Innovations, described the bureaucratic challenges faced at the municipal level to ensure water for irrigation for commercial farming, due to a lack of historical irrigation data for the area.

Discussing climate intelligence, Nils Hempelmann, Open Geospatial Consortium (OGC), highlighted the OGC’s work, including in climate resilience through the OGC climate resilience community, guided by the FAIR principles. He explained that the OGC, among other aspects, uses artificial intelligence to fill in gaps where data is not readily available and processes large climate resilience data sets.

AfriGEO Symposium Launches: Davis Adieno, Global Partnership for Sustainable Development Data (GPSDD), introduced the launch of the **Africa Data Capacity Accelerator for Climate and Health**, in partnership with data.org’s Capacity Accelerator Network. He noted that the partnership brings together stakeholders interested in using data to track SDG implementation. He underlined that the Accelerator prioritizes: timely data, inclusive data that ensures agency for vulnerable groups, and accountable data.

Ronda Zelezny-Green, Capacity Accelerator Network at data.org, introduced the Network noting its support for data for social impact. She stressed that data.org works to increase data capacity, using the data commons, and identify best practice cases of data for social impact.



GPSDD launched the Africa Data Capacity Accelerator for Climate and Health, in partnership with data.org’s Capacity Accelerator Network (L-R) Ronda Železný-Green, data.org, and Davis Adieno, GPSDD

Adieno recalled the challenges related to data in Africa and noted the lack of skills in data services that were laid bare during the COVID-19 pandemic. In response, he pointed to the Africa Data Capacity Accelerator launch, which will mobilize existing capacity on the continent. He said the aim was to produce a 200-strong cohort of data scientists in the region, and identify organizations who would benefit from grants to work on climate and health.

Zelezny-Green highlighted that one in five people die due to climate-related impacts and said data.org plans to train one million data practitioners by 2032 to address these. Noting the Accelerator is set to work over three years in Africa and India, Adieno called on stakeholders with open data sets to partner with GPSDD and data.org to ensure the Accelerator’s success.

Amadou Dieye, AfriGEO, introduced the launch of **SERVIR West Africa Phase 2**, under the theme “connecting space to village,” noting SERVIR West Africa is a partnership between the US Agency for International Development (USAID), NASA, and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). Participants watched a video on SERVIR West Africa, which uses EO to assess water resources in water-scarce regions in West Africa, assists in agriculture planning, and tracks water resources for herders and pastoralist communities.

Ramadajita Tabo, Regional Director, ICRISAT, noted that technology had transformed lives over the last two decades, including through geospatial information. He highlighted the need for geospatial information in supporting food security policies, and addressing climate change, biodiversity loss, and other challenges. He underlined that technological advances have a lot to contribute, but require the capacity to innovate, which can come from marginalized voices and minds, among others. He drew attention to the importance of industrialization of EO services to meet dynamic user needs over the coming years. He shared his expectation that SERVIR West Africa will engage users and ensure no one is left behind.



The dais during the launch of SERVIR West Africa Phase 2

Mahalmoudou Hamadou Maiga, Director General, AGRHYMET, welcomed the launch of SERVIR West Africa Phase 2, noting its benefits for the countries in the Sahel region, linking space to the village to improve the lives of vulnerable people. He reiterated his appreciation to NASA, ICRISAT, and USAID for the work done to operationalize this programme in both phases and wished the partners further success.

Lawrence Friedl, NASA, noted that SERVIR brings insights from Earth Science to benefit those on the ground. He noted the SERVIR-NASA partnership and expressed “belief and faith” in the West African geospatial scientific community. He highlighted the project has helped NASA scientists grow and learn, and lauded the regional partners for their work, particularly in addressing the impacts of artisanal mining.

Jo Lesser-Oltheten, Director of West Africa Mission, USAID, noted this phase will run until 2032. She underlined the importance of SERVIR using cutting-edge data to provide solutions to 21st century problems. She noted this technology was now available to communities, governments, civil society, and the private sector, who can use it to craft informed solutions to challenges on the ground. She underscored the need to understand what works or does not in development assistance and planning.

SERVIR West Africa Small Innovation Grant Ceremony: Lydie Hakizimana, CEO, African Institute for Mathematical Sciences, introduced the session by explaining that the idea for the awards came from a desire to reward the best minds in STEM on the continent. She lauded that of all those trained in STEM over the last 10 years, 32% are women. She underlined the need to train African scientists in order to fulfill the wish that the next Einstein comes from Africa.

For these awards, she noted that from the six selected recipients, four are women. The award recipients were: Pauline Ornela, Cameroon; Fatoumata Haidara, Niger; Soona Sedahmed, Sudan; Isaac Doku, Burkina Faso; Yacouba Ouedraogo, Senegal; and Das Dore, Senegal.

AfriGEO Closing Session: On Tuesday afternoon, the session moderator Amos Kabo-bah, Acting Dean for the International Relations Office, University of Energy and Natural Resources (UENR), provided brief summaries of the sessions over the two days, and moderated a brief closing discussion.

Dan Irwin, SERVIR, lauded the “growth and maturity” of the African geospatial community and expressed appreciation for the AfriGEO’s Secretariat for its work and the community for its vision and energy in expanding the space-related interest.

Ronda Zelezny-Green, Capacity Accelerator Network at data.org, underscored the need for “more and better” collaboration on capacity building. She stressed that “we cannot afford not to do this data work” because it is the bedrock for action on climate, Indigenous Peoples issues, health, disaster risk, and agriculture, among others.

Mmboneni Muofhe, Department of Science and Technology, SOUTH AFRICA, underlined that every little action on the GEO spectrum is based on individual will to improve the experiences of all the people in Africa. He highlighted the need



Group photo at the end of the AfriGEO Symposium

for partnerships to ensure GEO remains a success, pointed to a movement of Africans in the diaspora in the GEO space, and underscored the need to cultivate community science to strengthen data collection on the continent.

Kabo-bah stressed that this AfriGEO session was just the start and will provide the impetus to the younger generation to take up the GEO mantle. Thanking the AfriGEO partners, and all the participants, he called on all stakeholders to work together to transform decision-making processes through EO. He closed the Symposium at 6:55pm.

Industry Track

On Monday and Tuesday, the Industry Track met under the theme, “Public-Private Partnerships (PPP): A Catalyst for Local Action.”

Moderator Kamal Ramsingh, Chairman, ZASPACE, welcomed participants to the opening session and highlighted the momentum for discussing PPPs. GEO Secretariat Director Yana Gevorgyan underscored PPPs as accelerators of global action. She mentioned that GEO creates a coordination space for the data providers and that GEO week provides an opportunity for the industry to think about how GEO post-2025 should look like.

Henry Kwabena Kokofu, Executive Director, Environmental Protection Agency, GHANA, stressed that PPPs are the first step to change Africa and foster the requisite trust. He pointed to much innovation in Africa today and said the youth’s role in it must be recognized.



Moderator Kamal Ramsingh, Chairman, ZASPACE



Yana Gevorgyan, Director, GEO Secretariat

In a keynote address, Albert Momo, Executive Director, Trimble Inc., focused on building geospatial infrastructure through PPPs. He addressed the relevance of understanding PPPs for the geospatial sector, including infrastructure, services, data and platforms, innovation, and geographic coverage. He stressed that in the digital transformation era, technology-forward solutions deliver digital insights that solve physical world problems, with Global Positioning Systems (GPS) as the base of that transformation. For him, PPPs should consider the scope, legal framework, business models, operation and manufacture, local presence, and technology adaptation as key components for success.

Sean Breyer, Esri, spoke on partnering to transform EO into actionable information, underscoring that Esri was one of the first GEO partners and that there are many ways of partnering around open data sources, making readily available large amounts of data on land and coasts, and in the Ocean. He mentioned that many users and research applications, including Atlas, the United Nations Environment Programme (UNEP), National Geographic, Mission Blue, and others.

Pauline Okeyo, Esri, highlighted the ways Esri partners with the GEO Community. She showed how the DEA GeoPortal inspired other regional GEO platforms, such as AmeriGEO—and detailed the ArcGIS Living Atlas, which includes ready-to-use content on instant and historical information.



Albert Momo, Executive Director, Trimble Inc.

PPP Challenges in the Geospatial Sector and the Way Forward: Irene Benito, Planet, facilitated this panel discussion, which began by sharing perspectives on PPPs, including the importance of having a legal framework, the need to embrace the digital era, and the “3 Cs” essential for PPPs: communication, coordination, and collaboration. Among the identified gaps mentioned, they discussed different scopes and interests of private actors and the historical challenges of the Global South. Examples and details were provided from successful African initiatives.

A subsequent discussion highlighted PPPs as comprehensive solutions providers, the relevance of having all actors around the table, and capacity building. It was noted that to address the problem of delivering quality public goods and services, the government should bear in mind that financial and technical assistance from the private sector is needed.

In the ensuing discussion, participants and panelists addressed issues related to critical components for successful opportunities for local businesses, actions undertaken thus far, and where the identified gaps lie.

Defining PPPs Within GEO: Arnold Hougham, Pinkmatter, facilitated a session of panelists representing the private, public, and non-profit sectors. Interventions highlighted the importance of PPPs to achieve government goals and the social responsibility of the private sector, including how, with the private sector’s help, governments can be much more efficient in delivering on their commitments. Challenges mentioned included government rotation and consistency among different administrations.

Examples of EO technologies used collaboratively across the private, public, and non-profit sectors were also provided. Participants underscored that: PPPs try to solve identified problems collaboratively; they are based on sharing, with benefits to both parties; PPPs create the balance to achieve better outcomes for all parties; and PPPs are engaged to bring together human, material, and non-material resources to provide concrete outcomes. Also mentioned was that the pool of resources defines the type of PPP established and that NGOs can be the bridge between the public and private sectors in developing PPPs.

On the impact of EO for the 2030 Sustainable Development Agenda (EO4SDG), Laurent Durieux, GEO Secretariat, stated that the initiative was created in 2015 when different actors and stakeholders joined to foster the use of EO to achieve the SDGs by delivering integrated monitoring frameworks to support MEAs and countries in the decision-making process. Some EO4SDG results were highlighted, including the SDGs Geospatial Roadmap, EO informing human settlements: Monitoring and Resilience Planning, the EO toolkit for sustainable cities and human settlements, the JAXA High-resolution Land Use and Land Cover Map, and an analysis of deforestation due to mining in Southwestern Ghana.

Road to 2030: Opportunities for EO to Power Progress Towards the SDGs and Build Integrated Solutions: Laurent Durieux, GEO Secretariat, moderated the panel. Lorenzo de Simone, Food and Agriculture Organization of the UN (FAO) and EO4SDG Board Chair, referred to the FAO development of EO methods for direct and indirect SDG estimation and



Participants during the presentation made by **Alessandra Casazza**, UNDP

disaggregation. He discussed SDG 15.4.2 (mountain green cover index) for developing EO to assess SDG progress.

Alessandra Casazza, UNDP, focused on the gaps, scaling up the opportunities, and capacities and capabilities needed on EO for the fourth industrial revolution. She explained the integrated analysis of drought resilience in the Horn of Africa, which included mapping tools, pastoral communities' risk, land use changes, groundwater, evapotranspiration, reservoir and lake storage, information dissemination, crop production estimation, and market transparency.

Olivia Jimena Juárez Carillo, National Institute of Statistics and Geography, MEXICO, explained EO Open Data Cube's contribution to producing information for sustainable development in Mexico. As a concrete and technical case, she explained the indicators related to SDG 6.1.1 for water surface ecosystems on a national basis. She also shared the experience related to indicator 15.1.1 on forest area as a percentage of the total land area using Landsat data.

Brian Killough, NASA, US, explained that the Committee on EO Satellites contributes to the SDGs through open data cubes, open science, and Digital Earth initiatives for Africa, the Americas, and the Pacific.

Potential for Developing PPPs for Geospatial Technologies and EO: Moderated by Albert Momo, Trimble, this session took place on Tuesday, 2 November. Keynote speaker Willy Govender, CEO Terra Analytics, South Africa, stressed that there is “no better time than now for geospatial PPPs” due to the need for greater effectiveness in pandemic response and rising costs and reduced government funding. He discussed key takeaways from the World Geospatial Industry Council's report on “Greenhouse Gas Monitoring from Space: A mapping of capabilities across public, private, and hybrid satellite missions,” with lessons for PPPs, including the growing monitoring capability of private sector companies for specific greenhouse gases and new opportunities arising with artificial intelligence and other frontier technologies. He described indicators of PPP “readiness” in Africa, noting that highly ranking environments were those where political risks are low and where tailor-made

contracting models could be developed for different components of the EO industry.

Tidiane Ouattara, AUC, presented on the “state of play” of African PPPs, noting the need for a “model change” to give more opportunities to the private sector and stressing that “space is not just about humanitarian business; it's about spending and making money.” He underscored that EO is on an upward trend growing by 13.8% from USD 150 million in 2019 to USD 170.7 million in 2021, but he noted some challenges with EO private markets in Africa, including a skills gap, cross-border scalability, unstructured business models, and “too much focus on products and less on targeted services.” He highlighted factors that support industry growth, including openness to working with international partners and encouraging start-ups and spin-offs from university research programmes.

In a panel discussion, moderated by Gcobisa Fadana, South Africa Space Agency, panelists discussed recommended risk and reward models for a successful PPP. Emily Smail, GEO Blue Planet Initiative, mentioned that small companies are likely to bear higher risks, and that opportunities exist for private companies to sell data on Ocean data infrastructure to satisfy public sector demand. On rewards, she identified small business innovation research grant initiatives as well as “high risk, high reward” incentives depending on the risk appetite of different companies.

Jose Luiz Moutinho, Atlantic International Research Centre, stressed that risk reduction can be achieved by “having a clear goal” that can encourage private partners to identify innovative solutions to meet specific data gaps. Kwaku Antwi, African Open Data Institute and Internet Research Foundation, Ghana, emphasized that private partners should “pick and choose where they see benefits” to minimize risks they are willing to take. He also noted that rewards could be maximized when companies are in open conversation rather than working in silos.

Lessons from SMMEs: The penultimate session of the Industry Track, moderated by Albert Momo, Trimble, heard



L-R: **Gcobisa Fadana**, South Africa Space Agency; **Emily Smail**, GEO Blue Planet Initiative; **Jose Luiz Moutinho**, Atlantic International Research Centre; and **Kwaku Antwi**, African Open Data Institute and Internet Research Foundation, Ghana

four small, medium and micro enterprises (SMMEs) present their EO solutions to a panel with Momo, Madeeha Bajwa, GEO Secretariat, and Patricia Cummins, Esri. Vivianne Meta, LocateIT Limited, Kenya, presented on her enterprise, which aims to provide geomatics products and services pillared on remote sensing, EO, Geographic Information Systems (GIS), airborne sensors, and Geo-Apps at various scales, from local to Africa-wide. Meta responded to comments on, among others, potential competitors, and the potential role of her company's services for LDN monitoring.

Kevin Imani, Open Forest Protocol, Kenya, described his blockchain-enabled platform as the world's first decentralized Open Measurement, Reporting, and Verification (Open-MRV) of carbon credits through the sale of Non-Fungible Tokens (NFTs). In response to comments on collaborating with GEO's working group on climate change and clarity on the market for his product, Imani stressed that local communities should be informed that "there is money to be made from the CO2 in their trees" and that collaboration with GEO would be strengthened as the business moves beyond reforestation and afforestation demand into forest and mangrove conservation.

Dáire Boyle, Evenflow, presented his company which he stated, "helps others provide value to the market." He described how Evenflow provides support on the commercialization of space-based applications, contributes to the GEO Knowledge Hub, and offers a "Sustainability Booster" service to space technology start-ups and SMMEs through a suite of services including customer diversification, branding and marketing support, and connecting with potential investors. Boyle mentioned that his company plans to increase business-to-business services and improve communication of sometimes complicated EO terminology through storytelling.

Stephen Djaba, Geo-Tech Systems Limited, Ghana, described his company as providing critical geospatial technology for, among others, mobile mapping, meteorology, GIS, construction, survey, agriculture, and earthquake and dam monitoring, as well as establishing an Israeli-Ghanaian PPP, GMX Systems Ghana Limited, to provide high precision Global Navigation Satellite Systems to the Ghanaian market. Djaba noted his company's business model aims to double the growth of Continuously Operating Reference Stations in Ghana.

Approaches, Opportunities, and Challenges to Enable Trust and Develop an Inclusive Environment for EO Data Programmes: The final panel of the Industry Track was moderated by Madeeha Bajwa, GEO Secretariat.

On what "enabling trust" with EO data refers to, Omar Seidu, Ghana Statistical Service, stressed that it is about clearly understanding the value added between public and private partners. Patricia Cummins, Esri, emphasized that "trust begins with relationships; without relationships there cannot be collaboration." Meghan Halabisky, DEA, stated that trust is about being open and transparent to build confidence in partnerships. Joe Flasher, Amazon Web Services, stated that trusting relationships with open data involves transparent communication to end users about where data comes from.



A discussion panel during the session on Approaches, Opportunities, and Challenges to Enable Trust and Develop an Inclusive Environment for EO Data Programmes

On successful strategies to build relationships, Cummins mentioned going beyond the geospatial technology community to connect with government and trade associations to better learn about different partners' needs. Halabisky stressed the importance of combining quantitative scientific data with "qualitative gut checks" that iteratively enrolls valuable feedback as relationships of trust in the release of the final product.

On mechanisms to sustain trust, Flasher stated that retaining financial commercial relations will ensure the longevity of partnerships, stressing "you don't want to be dependent on goodwill." Panelists held different but complementary views on the notion that building technology will attract investors, with Cummins underscoring that geospatial technology will be successful when it solves a specific problem. Flasher stressed that "proof of concept" is where novelty arises and can be transformative in itself. In conclusion, Flasher stressed that enabling trust means to "say what you mean, mean what you say, and do whatever you will say you will do." Halabisky stated that trust should have a "human" face that is iterative and co-produced. Cummins emphasized that "collaboration moves at the speed of trust and that collaborations are built through relationships," with GEO being a convener to this process of trust-building.

Youth Track

Panel Discussion with Young Women in GIS: Moderator Mary Namukose, Women in GIS-Uganda, led a panel discussion for the GEO Youth Track on young and mid-career women in GIS and EO, involving young women sharing their experiences in using GIS/EO and inspiring others around the world.

Yana Gevorgyan, GEO Secretariat Director, introduced the first Youth Track session, urging participants to identify a unified message of what it means to look to the future where decisions are being taken by citizens, governments, and businesses, and informed by EO.

In a keynote presentation, Mónica Estébanez Camarena, Delft University of Technology, stressed some challenges for women in the field of GIS and EO, including: underrepresentation and



Liliana Castillo Villamor, Aberystwyth University, and Yana Gevorgyan, GEO Secretariat Director

lack of role models; low recognition, including downplaying of intellect, knowledge, experience, and leadership; harassment in the workplace; and circumstances that can hinder education and professional development, including family and community responsibilities, and societal norms and stigma. On post-2025 goals for GEO, she emphasized the need to involve women and young girls from defining the problem to the provision of solutions, ensuring greater female representation in the public and private sectors, and improving targeted training and mentorship programmes.

In the panel discussion, Keren Asaba, TOA Custodian Nigeria Limited, described her experiences as the only woman in a team of 15 male drone pilots. She highlighted the importance of expressing oneself with confidence and reaching out to male counterparts as allies.

Ayeisha Sheldon, UN Satellite Centre, highlighted how professional networks can help young women grow their careers, both personally and professionally. She noted that social media has helped amplify these networks but stressed that more robust campaigns are needed so young people get to know about them in the early stages of their careers.

Liliana Castillo Villamor, Aberystwyth University, emphasized how understanding what farmers need has helped her to translate technical jargon on EO to farmers while learning from them to create solutions together.

In the ensuing discussion, panelists and participants discussed, *inter alia*: strategies to break down barriers for young women to participate in EO and GIS; ensuring knowledge transfer from North to South; increasing private sector involvement; and not downplaying the value and role of men to enable transformation in the sector.

Youth and Industry Track: On Monday, this event moderated by Thokozile Miya, tech start-up entrepreneur, provided space for discussions about career opportunities and entrepreneurship for young people in the fast-growing geospatial sector, including EO.

Kamal Ramsingh, ZASPACE, shared perspectives on encouraging young people to work in the geospatial sector, noting Africa has generated high levels of venture capital and

needs to “build the talent pipeline” early to encourage new entrepreneurs in science, technology, and mathematics-related fields.

In a series of “lightning talks,” panelists comprised of early career professionals and industry representatives shared their experience and tips on how youth can propel their careers in the EO sector.

Arnold Hougham, Pinkmatter, urged young people to “find your passion and stay with it,” stressing how the EO industry is booming, particularly through private sector growth and demand in small satellite constellations collecting detailed information about the Earth’s surface.

Alison Bedoya, GEO Pathways, spoke about concrete strategies to develop spatial data in which young people connect with professionals and develop knowledge and skills using geospatial data and technology. She gave the example of a “mapathon” in Peru, which was used for the commemoration of Peru’s bicentennial independence celebration in 2021 and for DRR monitoring.

Irene Benito, Planet, shared her reflections as a young professional in the geospatial sector dedicated to achieving gender balance in the field. She stressed that the best way to advance gender equality in the workplace is to “excel and push ourselves” as women and to seize every opportunity to grow professionally.

Albert Momo, Executive Director, Trimble Inc., shared his professional trajectory as a computer science graduate to writing software for GIS, and eventually designing NASA’s SERVIR programme “to bring geospatial solutions to the developing world.” He said his commitment now lies with female empowerment in the workplace and to do his best to create an environment where underrepresented minorities can thrive in the sector.

Pauline Okeyo, Esri, offered three pieces of advice to encourage youth to flourish in the geospatial sector: being part of a professional network, taking initiative, and being flexible.

During the discussion, panelists and participants noted the need to: attract more diverse talent in the geospatial sector; increase inclusivity by reflecting on the value added that geospatial jobs offer for youth career prospects, in the private sector and within national governments; and focus on putting resources in empowering youth to become leaders.



Group photo of participants and panelists of the Youth Track



Mark Urban, RedCLARA

Road to GEO Post-2025: Omo Oaiya, WACREN, moderated the session. Mark Urban, RedCLARA, highlighted the importance of strengthening capacity development and knowledge management in thematic areas around EO, articulating key institutions and organizations that impact SDGs.

Catherine Nabukulu, Women in GIS-Uganda, stressed the importance of a positive attitude and openness to networking, sharing, and listening. She proposed an incentive for youth participation and including them in financial conversations, especially through small working groups. On the post-2025 GEO, she underscored that youth should participate in the thematic working groups.

Through an interactive platform, participants provided their thoughts on topics, including: the way they use EO as researchers, for work, or as service providers; and methodological and thematic applications that are relevant for the future, including the cloud, data hubs, open data, and data-driven application development. They noted that these developments are used for decision making with respect to, among others, DRR, climate, water quality, biodiversity conservation, earthquake, tsunamis, urban planning, sea level, agriculture, and environmental management.

Addressing the most significant opportunities and challenges for youth engagement in GEO, participants mentioned: “big data,” youth networking, and partnerships. Participants also



Catherine Nabukulu, Women in GIS-Uganda

mentioned open access to data, tools, and equipment as lead responses for a “dream” EO situation. They concluded by specifying ideas to convey to the Post-2025 Working Group for its consideration with respect to a post-2025 GEO, including more incentives for youth engagement and representation, training, mentorships programmes, youth recognition in EO, openness, research funding, collaborations, EO professionals mentoring youth, and a youth-industry link.

In final remarks, Michael Gould, highlighted the need to raise ambition and take advantage of all networks. He mentioned that the key is capacity development to the 21st century-required skills level.

Water and Youth—Engaging the Next Generation in Science and Policy: Albert DeGarmo, NOAA, moderated the session. Igor Chernov, WMO HydroHub, explained HydroHub and the United International Federation of Youth for Water and Climate (UNIFY) initiatives. He underscored challenges to addressing youth engagement, such as increasing visibility and connectivity to young professionals and start-ups, communication, participation, and partnerships.

Maria Gorret Nabuwemboli, OpenStreetMap Uganda, explained the project to improve access to water and sanitation facilities in the informal settlement of Kampala using GIS. She highlighted data collection, tools, and community training as essential components for good outcomes, including water shortage inadequacy maps and the future construction of water points.

Oscar Daniel Beltrán Rodríguez, Institute of Hydrology, Meteorology and Environmental Studies, (IDEAM), Colombia, virtually explained IDEAM as a government institution that is part of AmeriGEO and provides support to the national environmental services. He detailed his institute’s involvement with the GEO Biodiversity Observation Network (GEO BON), GEO Global Agricultural Monitoring (GEOGLAM), Global Forest Observations Initiative (GFOI), and GEO Global Water Sustainability (GEOGloWS), as well as GEO expectations for his country, including knowledge gaps, needs, and improving relationships with young scientists.

Igor Ogashawara, AquaWatch, mentioned that EO can be used to collect data and as a tool to apply Integrated Water Resources Management (IWRM). He pointed to the recently launched GEO AquaWatch Early Career Society. He expressed some challenges in EO on water quality, including the lack of calibration and validation data and funding, atmospheric correction, sensor development, and training.

Cláudia Coleoni, Stockholm Environment Institute–Latin America, explained her research on mapping global coffee trade flows and water-related teleconnections in Colombia, where only 5.3% of Colombian coffee is consumed within the county. She noted that most of the coffee is consumed in Germany and Belgium. She also presented the “water beyond boundaries” approach using as case studies the Magdalena Cauca River Basin in Colombia and the Mekong River Basin.

Fifi Adodo, GEO Blue Planet, explained the goal of GEO Blue Planet, its work within Africa, the Secretariat structure, and

the core action areas, which include stakeholder engagement, cooperation, and co-design capacity development. He highlighted that GEO Blue Planet is working to engage youth in all these core action areas. He mentioned challenges in communicating Ocean and coastal data and information to non-experts and the need for sufficient training.

Side Events

IISD/ENB covered a selection of side events throughout the week.

Open Data Policies Global Overview and Focus in Africa:

On Monday, Florian Franziskakis, GEO Secretariat, welcomed participants to the side event and recalled the strengths of GEO membership in working together, enhancing social welfare, growing research and innovation opportunities, promoting new research and new types of research, and generating benefits for effective governance and policy making.

Alex de Sherbinin, Center for International Earth Science Information Network (CIESIN), Columbia University, emphasized the need for greater investment in data management capabilities and Indigenous-hosted data platforms and repositories. He acknowledged data producers who do share their data through open repositories.

Stephene Peedell, Joint Research Centre (JRC), European Commission, discussed the JRC's Copernicus services used in monitoring biodiversity hotspots and how they change over time. He stressed the importance of using data to identify land-use change drivers and to ensure positive use of the data through active engagement with partners.

Murali Krishna Gumma, ICRISAT, described the thematic areas of SERVIR West Africa in agriculture and food security, water and water-borne disasters, weather and climate, and land-use cover dynamics.

Igor Chernov, WMO, discussed the WMO Unified Data Policy in giving clear commitments to free and unrestricted data exchange and guidelines for national implementation and public-private engagement.

Emily Smail, Executive Director, GEO Blue Planet Initiative, University of Maryland Earth System Sciences Interdisciplinary Center, highlighted three challenges for geospatial data:

inaccessibility, data gaps from the lack of maintenance of *in situ* systems, and poor useability, with lack of curated products or regional capacity in processing data.

Alessandro Scremin, RHEA Group, discussed the AfriGEOSS Community Portal, which fosters greater participation of African organizations in GEO, and develops EO disseminating data strategies to enhance technical capacity to create, access, use, and manage EO products and services.

Marie Françoise Voidrot, OGC, Bente Lilja Bye, CEO, BLB, Norway, and Lionel Menard, OGC, presented a recorded video on the Data Working Group motivations. She noted some key data-sharing principles that ensure metadata is shared in a timely manner. She also described how *in situ* licensing and machine learning have hastened data availability and uptake.

Digital Earth Global Session: Moderating this side event on Monday, Brian Killough, Committee on EO Satellites, NASA, US, welcomed participants and mentioned the importance of building a community to grow EO capacity.

Lisa-Maria Rebelo, DEA, highlighted that the economic value of EO data in Africa is USD 2.3 billion annually. She noted that DEA aims to provide a routine, reliable, and operational service using EO to deliver decision-ready products. She described DEA's first Africa-wide coastlines monitoring service that tracks, from the year 2000 to the present, continental changes of more than 60,000 km of coastline, and provides free interactive access to coastal erosion hotspots, rates of change, and average yearly changes in shorelines.

Aditya Agrawal, The Pacific Community, described Digital Earth Pacific as an "analytical cloud platform that makes remotely-sensed, analysis-ready data accessible via well-defined standards, and enables users to perform highly scalable EO tempo-spatial analysis using open-source data science libraries and models." He discussed the Digital Earth Pacific business case, creating a demand-driven, user-centric design, and identified next steps, including active fundraising, engagement with additional countries, demonstration data product development, and further development of the core infrastructure.

Olivia Juárez Carillo, National Institute of Statistics and Geography, MEXICO, described the potential for establishing a sustainable framework on EO in the Americas. She highlighted



Emily Smail, Executive Director, GEO Blue Planet Initiative, University of Maryland Earth System Sciences Interdisciplinary Center



Olivia Juárez Carillo, National Institute of Statistics and Geography, Mexico

the importance of the Aguascalientes Declaration, which identified as key strategies for going forward the collaboration for improving communications on EO, increasing capacity for the acquisition and use of geospatial data, and establishing relationships and cooperation mechanisms to promote the integration of geospatial data. She offered applied examples of how the Mexican Geospatial Data Cube was used to, for instance, visualize the impact of public policy to successfully recover Mexico's Lake Chapala from overexploitation.

In the ensuing discussion, participants discussed the need to: identify stakeholders to develop case-specific data needs; build trust between partners: tailor data platforms to current political priorities in specific countries; foster strategies for greater collaboration, including through technology sharing and algorithm sharing; and build capacity between data science and open-source communities.

Evidence-based Decisions and Impact Through

National GEOs: In this event, moderated by Nancy D. Searby, NASA, US, participants discussed various models of national coordination mechanisms that provide opportunities for state agencies to strengthen partnerships, understand their interconnected needs, and integrate EO data, tools, and services into their work to generate solutions.

Virginia Burkett, US Geological Survey, described the US GEO's recent accomplishments, including developing a national plan for civil EO, carrying out a satellite needs assessment, and conducting industry dialogue sessions. She noted that the US GEO strengthens engagement and participation in EO by creating a forum for agency collaboration, increasing cost-effectiveness through collaboration and joint work financing and establishing international partnerships. She lamented that while a mandate exists, funding by individual agencies can hinder coordination.

Shannon Kaya, Environment and Climate Change Canada, described Canada's recent milestones in developing a national GEO strategy. She highlighted the value added of Canada's national GEO, including accessing international expertise, influencing international best practices, fostering connections to Canadian EO innovation and technologies, and accessing knowledge and data to support research.



Melanie Hutchinson, Defra, UK

Melanie Hutchinson, Defra, UK, highlighted the UK's GEO strategy jointly established by Defra and the National Centre for Earth Observation, and drew attention to the UK Space Agency. She underscored the benefits of a joint approach, including bringing together the technical and policy expertise of the partners, providing strength in a collective voice, and supporting sound science for effective solutions to global challenges at multiple levels.

Zhichun Liu, Ministry of Science and Technology, CHINA, described the structure of China's National GEO, its strategy over a 10-year period and showcased the connectivity of the country's national public satellites, with a network that provides users with a "one-stop" data access service.

Lulu Makapela, Department of Science and Innovation, SOUTH AFRICA, underscored the expected outcomes of South Africa's GEO, including: enhanced capacity to access, use, and manage EO data; reduce the duplication of efforts; ensure interoperable, discoverable, and accessible EO data through national platforms. and increased representation of women, youth, and SMMEs.

Shiloh Osaе, Ghana Space Science and Technology Institute, described the progress of the Ghana Space Policy, approved in 2020, which aims to promote a well-coordinated space science sector to leverage EO data to achieve the SDGs. He noted the benefits of a national GEO in Ghana, including the capacity to rally under a common voice and jointly seek funding.

Earth Observation and Health: Early Warning Systems and Beyond! The side event on Tuesday, moderated by Franz Immler, European Commission, provided key examples of how EO offers valuable insight for health decision making.

Haris Kontoes, Institute for Astronomy and Astrophysics Space Applications and Remote Sensing of the National Observatory of Athens, GREECE, received the European Innovation Council's Horizon Prize of Euros 5 million in 2022 for establishing an early warning system to address worldwide epidemics caused by mosquito-borne diseases. He described how the early warning system guides targeted peri-urban larvicidal actions and door-to-door awareness campaigns. He highlighted that it is expanding every year to new regions with different climatic and socioeconomic conditions.



Participants listen to the presentation made by Shannon Kaya, Environment and Climate Change Canada

Dennis Laryea, Ghana Health Service, underscored the importance of relying on the monitoring of sewage and wastewater in an increasingly dryer climate, as a predictor to identify the risk of outbreaks in Ghana.

Gina Tsarouchi and Darren Lumbroso, HR Wallingford, presented the D-MOSS system that gives health officials in Viet Nam, Sri Lanka, and Malaysia advance warning of likely outbreaks of dengue fever. They stressed the system predicts outbreaks up to six months in advance, and includes water availability data using historical and live EO data.

After a video presentation of the FARSEER system, Frederic Bartumeus, Centre for Advanced Studies of Blanes, noted the system provides spatial models of vector-spread diseases such as dengue fever and offers reliable, scalable, and cost-effective early warning.

Abdoul-Azize Millogo, Institute of Social Sciences, BURKINA FASO, presented the Outreach Network for Gene Drive Research and the Target Malaria project. He noted that both initiatives bring together multidisciplinary teams of scientists to raise awareness on the value of gene drives for the public good and in using EO for base mapping of study areas for the spread of malaria in Burkina Faso.

Antar Jutla, University of Florida, presented a predictive intelligence system for cholera using EO. He demonstrated how predictive intelligence uses EO to flatten the curve through an anticipatory approach to coordinate interventions before outbreaks. Jutla also introduced the GEO Health Community of Practice as a global network of governments, organizations, and observers using EO to improve health decision making at the international, regional, country, and district levels.

Nikolaos Stilianakis, JRC, EUROPEAN COMMISSION, illustrated the historical spread timeline of the Zika virus around the world. He underscored that the combination of EO and satellite GPS can be used in compiling health risk maps that estimate the future distribution of vector species, including mosquitoes and ticks, under various environmental scenarios.

Juli Trtnaj, NOAA, US, described the National Integrated Heat Health Information System which identifies where extreme heat impacts might occur through urban heat island mapping.

Innovative Agriculture Monitoring for Improved Food Security: Honing in on capacity co-development and strengthening, this Tuesday side event addressed agricultural monitoring innovations and impact cases by GEOGLAM partners, geared towards enhancing agriculture production potential and responding to food security concerns in at-risk countries and regions.

Moderating the session, Ernest Acheampong, GEO Secretariat, underlined the need for EO tools to monitor and enhance agriculture and food security. He introduced GEOGLAM, noting its role in monitoring agriculture worldwide through detecting, for instance, crop damage.

Esther Makabe, Coordinator, GEOGLAM, shared that the Group has provided monthly reports on wheat, maize, rice, and soybean conditions since 2013. She noted that GEOGLAM assists countries in implementing national crop monitors and highlighted



Participants during the presentation made by **Kofi Asare**, Ghana Space Science and Technology Institute

that with a further expansion of the mandate of GEOGLAM, the Group now also works on climate change and DRR.

Hongwei Zeng, CropWatch, Aerospace Information Research Institute, Chinese Academy of Sciences, discussed capacity building for agricultural monitoring capacity building in Africa. He introduced CropWatch as a cloud platform for agriculture, processing large datasets and sharing information related to agriculture in different formats, including irrigated and rainfed cropland information. He noted the data is open to the public, sharing that partnerships are key to addressing the gaps in data coverage.

Kofi Asare, Ghana Space Science and Technology Institute, presented crop monitoring using EO for yield estimation in northern Ghana. He shared the development of a fit-for-purpose tool for agricultural monitoring that addresses the context on the ground in Ghana, noting this will likely rely on both ground observations and EO. He emphasized the desire for a crop monitoring explorer to enable farmers to collect and access data year round and called for funding for this project.

Joost Teuben, University of Twente, launched the “Guidance Document on Good Practices for the Designing, Implementing, and Evaluating Capacity Development Interventions in GEOGLAM.” He noted that the Guidance Document contains information on a model change theory, case studies from the GEOGLAM community, and lessons learned in the process.

In the ensuing discussion, participants asked about: the type of data submitted by states to GEOGLAM; information shared on agriculture and water between regions; the use of drones to avoid the satellites’ cloud cover challenges; and the need to translate the Guidance Document into other languages to facilitate wider implementation.

Open Knowledge and GEO Knowledge Hub: Florian Franziskakis, GEO Secretariat, moderated this Tuesday side event and introduced the GEO Knowledge Hub (GKH) and the Open Knowledge statement.

Felipe Carlos, Consultant GEO Secretariat, focused his presentation on the importance of preserving and making GEO community knowledge reproducible and fully open. On the importance of reproducible knowledge, including perspectives

from knowledge users who learn, apply, and share experiences, and the provider, which shares material and use cases, and helps the community. He explained that GKH promotes reproducibility, replicability, and preservation of EO applications by sharing all the essential resources to understand and reuse them.

Alessandro Scremin, GEOSS Platform, described the knowledge generation used to implement SDG indicator 15.3.1 (proportion of land that is degraded over total land area)—includes replicability, reproducibility, and reusability of the data—using the GEOSS platform. He explained this indicator is related to land degradation and how it undermines human well-being. The GEOSS platform processes the data until it becomes knowledge using a multi-scale analytical framework. He also addressed the Virtual Lab concept, a software framework used for the knowledge generation.

Samantha Musinzi, RCMRD, offered a perspective of a knowledge provider. She shared an overview of GKH, followed by the work scope of DEA knowledge packages to be accessible via GKH, its priorities, and knowledge available, which includes application, value add products, software, data sources, impact stories, data description, study location, engagement priorities, target audience, and publication. She explained the process of creating a knowledge package. As an example, she showed the knowledge provider process of monitoring chlorophyll-a in African waterbodies using the DEA Data Cube.

Orestis Speyer, National Observatory of Athens, exposed the EO Toolkit for Sustainable Cities and Human Settlements. He explained the origin and generalities of the EO Toolkit, which comprises datasets, tools, guidance documents, and use cases to support SDG 11 indicators. He referred to the European Horizon dashboard, which is helpful but hard to keep track of and reach users. From his perspective, and despite all efforts, he noted cities remain an elusive user.

Accelerating all SDGs Through the GEO-LDN Federated Tool and Capacity Development Approach: Moderator Antje Hechteltjen, Head, GEO-LDN Secretariat, introduced this side event. Barron Joseph Orr, Lead Scientist, UNCCD, explained LDN as a “no-net-loss approach to land degradation” introduced at Rio+20. He noted that it is embedded in both the 2030 Agenda for Sustainable Development as well as the UNCCD, underscoring that LDN underpins several SDGs. He stressed that achieving the SDGs requires comprehensive planning of land-use decisions, noting the drivers of land loss include unsustainable consumption and production. He highlighted the need for an approach that anticipates land degradation and considers the trade-offs among competing interests across the development landscape. Orr stated the need for the proper EO datasets and land-use planning experts to assess and analyze decisions. He highlighted the importance of the link between SDG reporting and LDN implementation, noting GEO’s role in this regard.

Neil Sims, Research Manager, CSIRO, and GEO-LDN Co-Chair, spoke on the LDN Toolkit, which collates resources in a meaningful way to allow access. He also explained how GEO-



Amos Kabo-bah, Acting Dean for the International Relations Office, UENR

LDN could use their workflow and resources to stakeholders in reaching their LDN goals. He highlighted as trends: Earth online platform for the implementation of SDG 15.3.1, and the LUP4LDN tool, which helps users decide on a pathway to LDN. Sims also pointed to standards and frameworks in the tools aimed at achieving LDN, noting all the tools are based on FAIR principles. He said the GEO-LDN is almost complete, including over 40 LDN open access datasets.

Amos Kabo-bah, Acting Dean for the International Relations Office, UENR, described elements of the new federated GEO-LDN capacity development approach to bridge the capacity gap, explaining the importance of targeted training for all the stakeholders involved across the broad spectrum of needs. He mentioned an international post-graduate programme on LDN in Ghana, massive open online courses (MOOCs), and the establishment of a network of land-use planners partnered with other relevant experts to fully identify complex land-use challenges.

Speaking on the implementation of the project “Tools for LDN,” Gabriel Daldegan, Land Systems Scientist, Conservation International’s Moore Center for Science, highlighted several open-access LDN resources which are also being co-created by users, who are encouraged to share relevant data

On overcoming barriers to the implementation of SDG 15.3.1, Olivia Jimena Juárez Carillo, Advisor of the Governing Board, National Institute of Statistics and Geography, MEXICO, shared that linking the value of Open Data Cube (an open-source geospatial data management and analysis platform) to the implementation of the 17 SDGs made a strong case for uptake of the tool.

Phoebe Oduor, RCMRD, and AfriGEO Point Person, shared the GEO Knowledge Hub, which is accessible to users interested in addressing LDN, and further pointed to coordinated approaches being rolled out to prevent the duplication of efforts. She stressed the importance of awareness and information sharing within communities of practice to build and enhance capacity. She drew attention to the gap due to old curricula which need to be upgraded frequently to keep up with new trends.

In the discussion, panelists then addressed, among others, how to avoid duplication of efforts, how to handle information that does not fit into all contexts at the development and use levels, and how best to embed EO information in national and regional planning processes.

Upcoming Meetings

UN Climate Change Conference: The 27th session of the Conference of the Parties (COP 27) to the UNFCCC, the 17th meeting of the COP serving as the Meeting of the Parties to the Kyoto Protocol (CMP 17), and the fourth meeting of the COP serving as the Meeting of the Parties to the Paris Agreement (CMA 4) will begin work on the Global Stocktake, among other matters. **dates:** 6-18 November 2022 **location:** Sharm el-Sheikh, Egypt **www:** unfccc.int/cop27

2022 Workshop on Earth Observation for Ecosystem Accounting (EO4EA 2022): The objective of this 2022 Workshop is to bring together experts in EO and in Ecosystem Accounting to jointly discuss the key challenges that need to be addressed in order to use EO in compiling national ecosystem accounts to support national policies. The Workshop will address the use of EO for ecosystem accounts in all realms, from terrestrial and freshwater to coastal and marine ecosystems. **dates:** 28 November–1 December 2022 **location:** online **www:** eo4ea-2022.esa.int/

UN Biodiversity Conference (CBD COP 15): This meeting includes CBD COP 15, the 10th meeting of the COP serving as the Meeting of the Parties to the Cartagena Protocol on Biosafety, and the fourth meeting of the COP serving as the Meeting of the Parties to the Nagoya Protocol on Access and Benefit-sharing. The meetings will review the achievement and delivery of the CBD's Strategic Plan for Biodiversity 2011-2020 and take a final decision on the post-2020 GBF, among other matters. **dates:** 3-19 December 2022 **location:** Montreal, Canada **www:** cbd.int/meetings

5th International Marine Protected Areas Congress (IMPAC5): IMPAC5 will bring together Ocean conservation professionals to chart a course towards protecting 30% of the global Ocean by 2030. IMPAC5 will be jointly hosted by the Host First Nations together with the Province of British Columbia, the Government of Canada, the Canadian Parks and Wilderness Society, and IUCN. Its goals include providing an opportunity for countries to come together to develop a roadmap to a post-2020 GBF for Ocean conservation and showcase the important role of MPAs in addressing the climate crisis and conserving biodiversity in a post-pandemic world. **dates:** 3-9 February 2023 **location:** Vancouver, Canada **www:** impac5.ca/

The Ocean Visions Biennial Summit 2023: The Ocean Visions Biennial Summit 2023 will focus on innovation to advance both knowledge and solutions at the Ocean-climate nexus. Organized by Advancing Earth and Space Science, the meeting will discuss existing and emerging problems at the interface of the Ocean and climate crises, with a forward look at projected climate conditions and how current and potential approaches and solutions can be effectively and sustainably

implemented. **dates:** 4-6 April 2023 **location:** Atlanta, US **www:** agu.org/Ocean-Visions-Summit

2023 GEO Ministerial Summit: At this Summit, delegates are expected to take decisions on the future direction of GEO. **dates:** 4-8 December 2023 **location:** Cape Town, South Africa **www:** www.earthobservations.org

Glossary

COP 27	27th session of the Conference of the Parties
EO	Earth observations
GEO	Group on Earth Observations
GEOGLAM	GEO Global Agricultural Monitoring Initiative
GEOGLoWS	Global Water Sustainability Initiative
GEOSS	Global Earth Observation System of Systems
GIS	Geographic information system
GOS4M	Global Observation System for Mercury
LDN	Land degradation neutrality
NAPS	National adaptation plans
NASA	National Aeronautics and Space Agency
NOAA	National Oceanic and Atmospheric Administration
PPP	Public-private partnership
SDGs	Sustainable Development Goals
SMMEs	Small, medium and micro-sized enterprises
UNCDD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change



During a field trip on Friday, participants learned about community mangrove restoration at the Songor Ramsar site.