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GEO Week 2021: 22-26 November 2021

Earth observation is the collecting of information about the Earth’s atmospheric, oceanic, and terrestrial systems, including changes to these systems over time. Earth observations (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.

GEO Week 2021 provided an opportunity for GEO to engage with its vast community, including the four regional GEOs—Afrigeo, Amerigeo, Eurogeo, and the Asia-Oceania GEO (AOGEO)—which, during the week, presented their work on, *inter alia*, land degradation neutrality (LDN), natural capital accounting, water resilience, and climate change.

GEO Week included the 17th meeting of the GEO Plenary, which focused on efforts needed 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 GEO Work Programme (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, disaster risk reduction (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. Through this engagement priority, GEO will support the use of EO in implementing the New Urban Agenda and continued work on SDG 11 (sustainable cities and communities).

In addition, the Plenary: considered progress by GEO in bridging the digital divide by democratizing access to data and technologies; and adopted the GEO [Statement on Open Knowledge](#), which emphasizes not only the concept of open science, but also of open access, citizen and participatory science, open data, software, hardware, and diversity of knowledge, among others.

Throughout the week, Anchor Sessions took place on multiple topics linked to the global policy agendas that underpin most



Zhang Guangjun, GEO Co-Chair and Vice Minister, Ministry of Science and Technology, China

of the GEO community’s work. These sessions explored the multidisciplinary nature of GEO through the concept of nexus thinking. GEO Week 2021 featured five Anchor Sessions on: the integrated implementation of GWP activities; climate action; climate and ocean; resilient cities and human settlements; and nature-based solutions (NBS).

The first-ever GEO Youth Track took place throughout the week, providing a participation opportunity for young people from around the world with an interest in GEO’s vision and mission. The event culminated in the creation of a Youth Community of Practice (CoP) within GEO to enable systematic engagement of young people in GEO’s work.

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GEO Week also included the Industry Track, which convened under the theme “Accelerating Action through Public-Private Partnerships (PPPs).” The event provided a platform for, among other things, 16 small, medium and micro-sized enterprises (SMMEs) to profile their companies and present their work on EO. The broader purpose of the event was to find areas in the GWP where SMMEs can both participate in and learn from activities.

GEO Week 2021 took place virtually from 22-26 November 2021 and brought together close to 1,600 delegates. GEO-17 Plenary sessions took place from 23-26 November; Anchor Sessions, from 23-25 November; the Youth Track began on 22 November; the Industry Track took place from 22-23 November; and many side events highlighted activities of the GEO community. This report summarizes the GEO Plenary, Anchor Sessions, the Youth and Industry Tracks, and selected side events.

It helps set the scene for defining a strategic mission for post-2025 GEO, which will build on the demonstrated achievements and integrate innovative changes that are necessary to meet the environmental and societal challenges of today and tomorrow using EO with support from the global GEO community.

A Brief History of GEO

GEO is a voluntary partnership consisting of Members, Participating Organizations, and Associates that are coordinating efforts to build the Global Earth Observation System of Systems (GEOSS). As a “system of systems,” GEOSS seeks to link existing and planned observing systems around the world, and support the development of new systems where gaps currently exist, with a view to providing key data to assist policy developers and decision makers. 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 between Plenary sessions, and the GEO Programme Board, which guides the GWP. The GEO Secretariat, based in Geneva, Switzerland, serves to execute the decisions of GEO’s governance and supports the work of GEO community. The GEO Plenary has been meeting annually since 2005.

GEO Members include the European Commission (EC) 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’s highest decision-making body. 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. Currently, GEO consists of 113 Members, 140 Participating Organizations, and 19 Associates.

Summary of GEO Week 2021

GEO Plenary

Opening: The 17th meeting of the GEO Plenary formally opened on Tuesday, 23 November. In opening remarks, GEO Co-Chair Zhang Guangjun, CHINA, reported on GEO China’s Disaster Data Response Mechanism, which has been activated to provide countries with high-resolution satellite imagery in support of disaster response planning. He cited the example of support to the Thai Flood Disaster Response through satellite post-disaster data.

GEO Co-Chair Mmboneni Muofhe, SOUTH AFRICA, lauded GEO’s efforts to strengthen regional work, and welcomed the selection of the South African National Space Agency as host of the Digital Earth Africa Program Management Office. This, he said, marks a significant milestone in ensuring the needs, challenges, and priorities of the continent are met through reliable access to EO data.

GEO Co-Chair Stephen Volz, US, highlighted increased recognition of GEO’s ability to provide good data to meet the objectives of, among others, the UN 2030 Agenda for Sustainable Development, the Paris Agreement, and the Sendai Framework.

Yana Gevorgyan, Director, GEO Secretariat, called on GEO Members to take note of the significant progress made in the GWP and other engagement activities and take the necessary action to facilitate connections across communities at national and local levels to accelerate the uptake of results by decision makers.

GEO Lead Co-Chair for 2021, Joanna Drake, EUROPEAN COMMISSION, praised GEO Members for progress in strengthening engagement with UN bodies, citing recognition by COP 26. She further mentioned GEO’s support of the post-2020 global biodiversity framework (GBF) to develop indicators. She urged ensuring relevance and outreach of GEO activities and data.



GEO Co-Chair **Mmboneni Muofhe**, South Africa

New Participating Organizations and Associates: The Secretariat introduced the new Participating Organizations that have joined GEO in 2021: Consortium of Universities for the Advancement of Hydrologic Science, Inc.; the UN Educational, Scientific and Cultural Organization (UNESCO) International Centre on Global-Scale Geochemistry; the International Research Center on Karst under the auspices of UNESCO; Open Source Geospatial Foundation; Inter-Islamic Network on Space Sciences and Technology; and the World Geospatial Industry Council. GEO also welcomed the following new Associates: Research Centre for Toxic Compounds in the Environment; D4DInsights; and Planet.

Approval of the Agenda: Participants adopted the agenda and the draft report (GEO 17/1.7b)

Mid-Term Evaluation Report and Response from Management: Mmboneni Muofhe introduced the Executive Committee's response to the [GEO Mid-Term Evaluation](#) (GEO-17-1.7a) on: GEO mission and value proposition; the relationship between GEO and the World Meteorological Organization (WMO); communication and engagement; re-evaluating GEOSS; user needs; international processes and connections; the role of regional GEOs; and planning for post-2025 GEO. Regarding a recommendation on improving the definition, targeting, and communication of the value propositions for external organizations to participate in GEO, he noted an iterative strategy for communicating tailored messages on GEO's value proposition would be developed. On another recommendation for a more structured way to collect and consolidate user needs across the GWP, he said the Programme Board and Secretariat would develop a common framework for analyzing users and decision challenges. One near-term action taken by the Executive Committee in response to Mid-Term Evaluation is to establish an Expert Advisory Group to reassess the concept of GEOSS and recommend an appropriate role for GEO to play in the provision of a common infrastructure to support GEOSS.

GEO Work Programme and Links to Global Policy Frameworks: On Tuesday, Anthony Rea, WMO, moderated the panel discussion on successful activities for providing key services to frameworks.

Nicola Pirrone, Research Director, National Research Council, ITALY, explained that the [Global Observation System for Mercury \(GOS4M\)](#) is a GEO Flagship aimed at supporting the Secretariat of the Minamata Convention on Mercury and the UN Environment Programme's (UNEP) Mercury Air Transport and Fate Research Partnership Area, as well as countries on the Effectiveness Evaluation and Global Monitoring Framework in relation to the Minamata Convention. He explained that GOS4M provides global data sets of comparable monitoring data by harmonizing existing regional and global scale networks and assessing the effectiveness of measures undertaken.

Sara Barsotti, Icelandic Meteorological Office, highlighted the successful experience of using observational data for volcanic civil protection. She explained that civil protection authorities in Iceland have collaborated with the scientific community for the



Anthony Rea, Director of Infrastructure, WMO

past few decades through a Scientific Advisory Board. In a crisis situation, such as a volcanic eruption, the advisory board can be activated on request, bringing together experts in relevant fields to present the latest data and information.

Amir Givati, Chief Science Officer, EnviroManager, Israel, discussed the GEO [Global Water Sustainability initiative \(GEOGloWS\)](#). He described how hydrological data and forecasts from the initiative enable the region to anticipate extreme weather events and take appropriate action, notably providing data as an independent body. He highlighted that the project contributes to several SDGs, especially SDG 6 (clean water and sanitation), and promotes equality, as all countries within the region have access to the same hydrological forecasts.

Lisa Maria Rebelo, Vice Chair, Scientific and Technical Review Panel, Ramsar Convention on Wetlands, highlighted that while many countries have wetlands, most do not address wetlands in their nationally determined contributions (NDCs) under the Paris Agreement. She said including wetlands in updated NDCs would help countries take a significant step towards raising their mitigation ambition, while supporting adaptation and resilience. Rebelo emphasized the use of EO for wetlands inventory, assessment, and monitoring, and underlined the importance of the GEO Wetlands Initiative.

Engaging the GEO Community: The Plenary resumed on Wednesday, with Evangelos Gerasopoulos, Research Director, National Observatory of Athens, and Director, Greek GEO Office, moderating the session on engaging the GEO community for strengthening the science-policy interface. The session began with a panel discussion on good practices and lessons learned from engaging policy and user communities.

Phoebe Oduor, AfriGEO Secretariat, Regional Centre for Mapping of Resources for Development, highlighted AfriGEO activities in the context of LDN, which entails combating desertification, restoring degraded land and soil, and striving to achieve a land degradation neutral world by 2030. She explained that three working groups on capacity building, data quality standards, and data analytics had been established, with the latter addressing minimum characteristics of data sets and

tools for making data accessible. On challenges, she discussed issues related to connectivity and infrastructure, and the need for policies to connect different institutions in order to work together and share resources.

Angelica Gutierrez, AmeriGEO, highlighted the AmeriGEO collaboration with partners on designing: a modeling system for natural capital accounting in Costa Rica; a remote-sensing based indicator of crop stress and drought conditions in Argentina; and a high-resolution multi-hazard study on climate change, based on an environmental fragility index in Guatemala and Puerto Rico. She noted that collaboration and strengthening of national GEO has positively impacted the region in terms of capacity development and investment in EO in the various countries.

Toshio Koike, Executive Director, International Centre for Water Hazard and Risk Management, JAPAN, presented on the [Asian Water Cycle Initiative \(AWCI\)](#), on behalf of AOGEO. He explained AWCI is building a nationwide network and decision-making platform on water resilience and disasters, which is supporting implementation of real-time flood monitoring and forecasting. Toshio provided an example of AWCI's work in the Philippines, where it supports the data integration and risk assessment components of the country's flood forecasting and early warning systems.

Thierry Ranchin, Director, Centre Observation, Impacts, Energy, Mines ParisTech, on behalf of Europe's segment of GEO (EuroGEO), discussed a science-policy interface example at the national level in France. In the presented case, the work was driven by policy question from the French Government to the French transmission system operator about how to reach carbon neutrality by 2050. This, he said, raised scientific questions about the appropriate climatic data, energy consumption and production scenarios, and energy mix to use. He highlighted the importance of EO data in providing an answer to the French Government in the form of recommendations, including a series of scenarios, for the French energy mix to achieve carbon neutrality by 2050. He further discussed how this example can be scaled up to the regional and global levels.

GEO Working Groups: This session showcased notable outcomes and key plans for GEO's work in the areas of climate action, DRR, and capacity development.

Allison Craddock, [GEO Capacity Development Working Group](#) Co-Chair, presenting results of the ongoing cross-

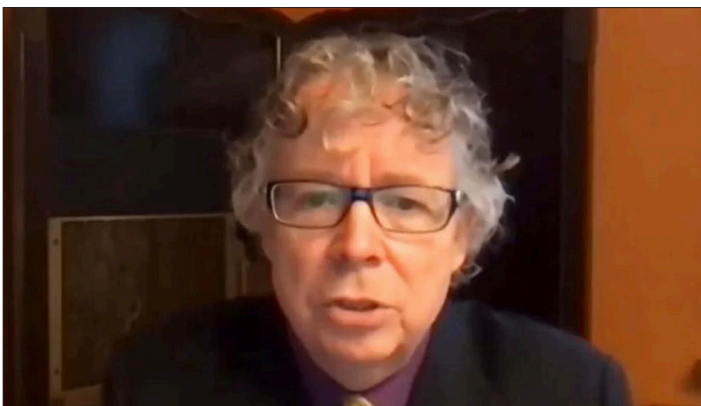
Working Group mapping of the GWP, reported that almost half of GWP activities focus on the three GEO engagement priorities. Reporting on the need for increased integration, she noted that several GEO communities focus on floods, drought, wildfires, landslides and earthquakes. The mapping exercise, she added, has also shown a need for more work with regional GEOs.

Lucia Perugini, Co-Chair of [GEO Climate Change Working Group](#) (CC-WG), presenting milestone events, reported on the GEO Climate Policy and Finance Workshop held in September 2021 to elaborate on contributions and the role of GEO in climate adaptation, and to seek a GEO mandate under the UNFCCC on data information. Reporting on the participation of GEO at COP 26, she noted that GEO, for the first time since 2007, was mentioned in the research and systematic observation negotiations, resulting in a recognition of GEO with reference to partnerships, biosphere observations, EO-related products, indicators and applications. She added that this is a first step toward seeking a mandate for GEO to provide regular input to the UNFCCC negotiations.

Kene Onukwube, Co-Chair [GEO DRR-WG](#), noted the group is strongly aligned to the Sendai Framework and its Priorities for Action. He discussed the [EO risk toolkit](#), which is being developed in collaboration with the UN Office for DRR (UNDRR), Esri and others, to provide data on hazards, vulnerability, and exposure to disasters.

Adoption of the Fourth Engagement Priority: Eleni Myrivili, Chief Heat Officer, City of Athens, Greece, noted that 50% of the global population is living in urban settlements. Noting this trend will continue, she underscored the importance for cities build resilience so they can survive and thrive. She highlighted social cohesion as one of the most important aspects of building resilience in cities. Using Athens as an example of a densely populated city, she highlighted the Athens Resilience Strategy for 2030, emphasizing the need for climate risk information in light of the worst heatwave in the summer of 2021 and challenges relating to missing data.

Evangelos Gerasopoulos, GEO Urban Resilience Subgroup, introduced the New Urban Agenda, explaining that by 2050, 68% of the global population will live in cities. He said the GEO strategy to support the New Urban Agenda includes: engaging cities and stakeholders to understand needs; communicating what GEO has to offer in the urban area; and supporting communities



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



Angelica Gutierrez, Co-Chair, GEOGloWS, and AmeriGEO

and countries to understand the value of EO for human settlements. Participants approved “Resilient Cities and Human Settlements” as GEO’s fourth engagement priority, which was driven by the New Urban Agenda.

Bridging the Digital Divide with Data, Tools and Knowledge: On Thursday, this plenary session built on GEO’s efforts to promote full and open access to EO data, provided experience sharing in implementation of data sharing principles, and highlighted good practice in data sharing, as well as supporting the development of local, nationally relevant services through access to new technologies and platforms.

Joanna Drake introduced this session, emphasizing the importance of ensuring data is available to support decision making in a manner that is open and analysis ready.

The panel discussion was moderated by Alena Rybkina, Deputy Director, Geophysical Center, Russian Academy of Sciences.

Discussing the importance of open data, Mercury Fox, Founding Director, Center of Excellence in Data for Society (CODATA), highlighted its role in national resiliency through enabling, among others, disaster modeling, and tracking and coordinating responses to disasters.

Jesus San Miguel-Ayanz, EUROPEAN COMMISSION Joint Research Centre, discussed the application of the Global Wildfire Information System (GWIS) for monitoring and tracking wildfires. He reported, among others, the ability to forecast fire danger 10 days before occurrence and to extract country profiles covering burnt area extent, fire frequency, seasonality, and landcover damage.

Peter Moore, Food and Agriculture Organization of the UN (FAO), providing a GWIS user perspective, noted the application’s ability to bridge the digital divide in countries where institutional and physical capacity to access and use EO data is lacking.

Omar Seidu, GHANA Statistical Service, described the [Digital Earth Africa](#) programme, which, he said, supports the realization of [Agenda 2063: The Africa We Want](#), by bridging the data gap in Africa. He presented a case study on deforestation in the Apamprama Forest Reserve in Ghana impacted by illegal mining and charcoal burning, where mapping of the extent of forest loss enabled enforcement of forest management through tracking illegal activities.

Carolina Adler, Executive Director, Mountain Research Initiative (MRI), and James Thornton, MRI, highlighted the [GEO Global Network for Observations and Information in Mountain Environments \(GEO Mountains\)](#). They highlighted its objectives, including improving monitoring and understanding of mountain processes and phenomena, and developing collective reporting capacity that responds to identified assessment and policy needs. Underscoring the importance of open data in the initiative, Adler and Thornton gave examples of outputs from GEO Mountains, such as the [Inventory of In Situ Observational Infrastructure](#), an online inventory and web mapping application.

Krishnachandran Balakrishnan, Indian Institute for Human Settlements, discussed the India Data Cube project, which consists primarily of deploying an open data cube to bring together time series of remote sensing and other statistical data. He explained the aim is to generate land cover, population, and

development indicator maps at sufficient spatial and temporal resolution to meet the needs of policymakers. Balakrishnan noted that the GEO-Amazon Web Services (AWS) cloud credits grant provided the project with the required computing power.

During the discussion, participants addressed a range of issues, including: extending the use of GWIS system data; obstacles to open data sharing and how to overcome them; whether data from the Landsat programme used in India can be transferred to different geographical settings; good practice for bridging the digital divide; and the important role of citizen science.

GEO Statement on Open Knowledge: Marie-Françoise Voidrot, European Director, Open Geospatial Consortium, provided the context, process, and a summary of the Statement on Open Knowledge. She explained it is more aligned with the GEO vision and mission to provide results orientated, evidence-based information for decision making. The statement emphasizes not only the concept of open science, but also open access, citizen and participatory science, open data, open reproducible research, open software, open infrastructure, open hardware, open education, diversity of knowledge, and the overarching goals of open knowledge.

Looking Ahead: During the final Plenary session on Friday, Brian Cover, Chief, Finance Division, WMO, presented the [2020 Financial Statement and Audit Report](#) (GEO-17-5.1a). He reported an increase in voluntary contribution pledges to GEO in 2020 compared to 2019, and said that at the end of 2020, GEO had a fund balance of CHF6.3 million. He also highlighted that GEO’s external auditors gave the reports an unqualified or clean audit opinion.

Lawrence Friedl, Director of Applied Sciences, National Aeronautics and Space Administration (NASA), US, and member of the GEO Budget Working Group, presented the [2022 GEO Trust Fund Budget](#) (GEO-17-5.1b (Rev4)), noting its adoption by the GEO Executive Committee. He outlined that the expected cash expenditure for 2022 is CHF 5.64 million, while expected income is CHF 4.3 million, leaving an expected shortfall of CHF 1.1 million. He announced the launch of the [GEO Pledge Campaign 2022](#) to cover this shortfall. Friedl urged GEO Members to contribute to the campaign and promote it among their networks.

The Plenary then approved the budget. CHINA expressed its intention to contribute to the GEO Trust Fund and participate in the Pledge Campaign. The EUROPEAN COMMISSION

A slide from the presentation of **Krishnachandran Balakrishnan**, Indian Institute for Human Settlements



Nataliia Kussul, Space Research Institute, NASU-SSAU, Ukraine

announced a contribution of Eur 1.2 million to the Trust Fund on behalf of EU GEO Members. SOUTH AFRICA announced a contribution of ZAR 3.5 million, consisting of ZAR 2 million to the Trust Fund and ZAR 1.5 million to support AfriGEO. He also expressed his country's intention to continue supporting GOS4M'S work in Africa. The US announced it will contribute more than CHF 750,000 to the Trust Fund, saying the exact amount will be confirmed in the coming months.

GEO Awards and GEO Art Competition Results: The GEO Awards Ceremony comprised of various awards and an art competition.

The [GEO SDG Awards](#), which were launched in 2019 and led by the [EO4SDG initiative](#), recognize institutions, organizations, and countries that are applying EO towards achievement of the SDGs.

The categories and winners of the 2021 GEO SDG Awards are listed below.

Sectoral Category Awards:

- GEO Member Country: Colombia and the United Arab Emirates (UAE);
- Intergovernmental: UN Development Programme (UNDP) Colombia, UNDP Ecuador, and UNDP Peru;
- SDG Custodian Agency: FAO; and
- Academia: Stanford University.

Special Category Awards:

- Innovation: The Netherlands Space Office;
- Testimonial/Story: Water@Reading Research Group, University of Reading; and
- Collaboration: UN-Habitat, NASA, the International Institute for Geo-Information Science and Earth Observation, the University of Twente, and the UAE Federal Competitiveness and Statistics Centre.

Special Mention award:

- Inspiring Hope for Youth: International School of Milan/Viola Mascarucci

The [GEO Individual Excellence Awards](#), which were launched in 2019 by the GEO Programme Board, celebrate individuals whose work is making a positive impact in improving the planet through EO.

The GEO Individual Excellence Awards winners for 2021 were:

- Brian Killough, NASA, US;

- Nataliia Kussul, Space Research Institute, National Academy of Sciences of Ukraine (NASU) and State Space Agency of Ukraine (SSAU);
- Guoqing Li, Chinese Academy of Sciences; and
- Stella Mutai, World Food Programme.

In addition, the first-ever [GEO Art Competition](#) was held on the theme “Mother Earth, I See You, I Hear You, I Feel You.” The GEO Art Competition winners were: Yunchen Yu (China), Klara Maisch (USA), Tara Illgner (USA), Emilia Novikova (Switzerland), Philip Samartzis (Australia), Grayson Cooke and Doug McKinnon (Australia), Raquel Santiago (US), Malú Cabellos (Peru), Meenalshi Pradeep (India), Laila Zhiyenbayeva (Czechia), Christian Klepp (Germany), Arnaud Quesney (France), Mohammad Rakibul Hasan (Bangladesh), Rhea Eason (USA), and Bernard Dissanayake Methuki Nethma Sanindi (Sri Lanka).

GEO Equality, Diversity, and Inclusion Statement: Nathalie Petteorelli, UK, GEO Programme Board, presented the GEO Equality, Diversity, and Inclusion (EDI) Statement, which was developed by the EDI Subgroup formed in early 2020 to ensure EDI is fully considered, addressed, and embedded within GEO activities and decisions. She highlighted the five pillars underpinning GEO's EDI vision, namely: oversight and accountability; community leadership and advocacy; creating a welcoming and supportive environment; outreach and engagement; and empowerment through accessibility.

She reported on consultations with the GEO community in the 2021 GEO Virtual Symposium, noting a general acceptance of the actions articulated for each pillar as appropriate for GEO.

The Plenary endorsed the EDI Statement. GEO South Africa noted the statement focus on inclusivity will have positive impacts on GEO activities. GEO China reported measures to support women in playing a greater role in science and technical innovation. The EUROPEAN COMMISSION urged that language diversity be strongly considered.

GEO Work Programme (GWP) 2023-2025: Andiswa Mlisa, SOUTH AFRICA, Programme Board Co-Chair, presented the GWP 2023-2025, which will be approved during GEO Week 2022. She highlighted weaknesses identified in the 2020-2022 GWP, including stalled outputs, few activities with ready for use results, and lack of synergies and collaboration across activities. She further presented the objectives of the new GWP's



Brian Killough, NASA

development, namely: greater collaboration and integration across GWP activities; stronger emphasis on open knowledge; specific identification of intended/actual users of the results from GWP activities; clearer definition of GWP categories; and simplification of the Implementation Plan template.

The EUROPEAN COMMISSION appreciated the emphasis on open knowledge and increased collaboration and called for additional efforts to simplify the implementation process. The UK welcomed attention to synergies of GEO activities.

Yana Gevorgyan noted that Joost Teuben has been seconded by ITC on virtual secondment to work in the GEO Secretariat and will support GWP activities in designing Impact Plans to enable impact-oriented approaches in the GWP.

Programme Board Members 2022: The Secretariat presented the nominations for members of the Programme Board for 2022, consisting of GEO Members: Finland, Ghana, South Africa, the UK, and the US. GEO Participating Organizations Board member nominees includes: Committee on Space Research, Eurisy, Mountain Research Initiative, Open Geospatial Consortium, and Plan4all. The Plenary approved the nominees.

Executive Committee Members 2022: The Secretariat announced the composition of the Executive Committee for 2022:

- for Africa: South Africa, Ghana, and Senegal, with South Africa as Co-Chair;
- for the Americas: the US, Costa Rica, and Peru, with the US as Co-Chair;
- for Asia/Oceania: China, Australia, Republic of Korea, and Japan, with China as Co-Chair;
- for the Commonwealth of Independent States: Armenia and the Russian Federation; and
- for Europe: European Commission, Germany, Greece, and Spain, with the European Commission as Co-Chair.

Announcement of GEO Week 2022: GEO Secretariat Director Gevorgyan announced the dates for GEO Week 2022 as 31 October to 4 November 2022. Noting it will most likely take place in a hybrid format, both virtually and in-person, she called for offers to host the meeting.

In closing remarks, Co-Chair Volz highlighted the GEO Mid-Term Evaluation, stressing that the comprehensive response to the evaluation will allow GEO to continue building on its successes while addressing its challenges and forging a path forward for an action-oriented GEO. He also congratulated GEO for accelerating meaningful engagement with young people and indigenous communities. Volz brought the 17th meeting of the GEO Plenary to a close at 2.03pm CET.

Anchor Sessions and Side Events

Integrated Implementation of GWP Activities: On Tuesday, this Anchor Session considered, among others, the importance of integration, synergies, and cooperation in the work of the GEO community for GWP implementation.

Sean de Cleene, Member of the Executive Committee, World Economic Forum, moderated this session, noting an increased demand for integrated global platforms to address sustainability challenges. He highlighted the bridging role of integrated data in breaking down sectoral silos in a more holistic manner.

Ian Jarvis, Director, GEO Global Agricultural Monitoring Initiative (GEOGLAM), said interconnectivity of information produced by the GEO community has the potential to catalyze integrated solutions. A common approach to essential variables, he added, may provide one way to enhance integration across the GWP.

Estefania Puricelli, GEOGLAM, presented a case study of the Parana Hydro Way in Paraguay, where agricultural production, transpiration, and markets have operated in silos to the detriment of the marketed soybean produced in the region. She reported on the need for policy sensitization on the importance of integration of sectors that support agricultural production. She further highlighted the Crop Monitor website, which provides timely, science-driven information on crop conditions in support of market transparency and early warning of production shortfalls.

Angelica Gutierrez, GEOGLoWS and AmeriGEO, emphasized the importance of historical data for evidence-based decision making and the need for continuous monitoring to understand the past in order to better predict the future. Using the Paraná River Basin as an example, she explained how historical data has highlighted the effects of land use and climate variability on the river's seasonality discharge.

James Verdin, Famine Early Warning Systems Network (FEWS NET), US Agency for International Development (USAID), explained that FEWS NET, funded by USAID, monitors the most food insecure countries around the world to mitigate famine and food insecurity by providing actionable, evidence-based analyses to program food assistance. He emphasized the need for a multidisciplinary approach, highlighting collaboration with GEOGLAM on crop monitoring and welcoming GEOGLoWS as a resource for integrating flood hazards into famine early warning analyses.

Thierry Ranchin, MINES ParisTech, highlighted e-shape as a unique initiative that brings together decades of public investment in EO and cloud capabilities into services for decision makers and other stakeholders. He explained that e-shape consists of 37 pilot applications under seven thematic areas addressing societal challenges, fostering entrepreneurship and supporting sustainable development. He then discussed strategies for implementing EuroGEO's contribution to GEOSS, aimed at bringing together EO resources in Europe with e-shape. He also highlighted e-shape tools for integrated implementation of the GWP.



Sean de Cleene, Member of the Executive Committee, World Economic Forum



Richard Spinrad, Under Secretary of Commerce for Oceans and Atmosphere and Administrator, NOAA, US

Climate Action: On Tuesday, this Anchor Session discussed ways in which EO can strengthen spending decisions by governments and international financial institutions on climate-friendly investments.

Robert Bradburne, Deputy Chief Scientific Adviser, Department for Environment, Food and Rural Affairs (Defra), UK, moderated this session, highlighting the emphasis of UNFCCC COP26 on financing for climate adaptation, mitigation, and resilience building.

Richard Spinrad, Administrator, National Oceanic and Atmospheric Administration (NOAA), US, urged the GEO community to maintain focus on data for climate action, highlighting the potential of the recently launched GEO report, [Greenhouse Gas \(GHG\) Monitoring from Space](#), to guide monitoring GHG emissions in preparation for the first Global Stocktake of the Paris Agreement in 2023.

Bobby Shackelton, Bloomberg, discussed the potential of EO for managing climate risk, noting increasing use of geospatial data to relate physical locations of companies' activities with disaster risk forecasts. He reported that companies are interested in raw statistical data rather than maps to augment their reporting practices and market transparency.

Ania Maria Grobicki, Green Climate Fund (GCF), presented on the GCF's investment in Climate Information and Early Warning Systems reported project financing of USD 1.8 billion with USD 2.2 billion co-financing. She urged the GEO community to support countries in their efforts to address historical data gaps to access climate financing.

Paul Desanker, UNFCCC Secretariat, provided an overview on supporting national climate action on adaptation through national adaptation plans (NAPs), which help reduce vulnerability to the impacts of climate change and coordinate activities in the country. He highlighted efforts to move towards a systems approach by optimizing how countries address climate change by investing in pre-emptive actions and addressing loss and damage after the fact. He noted that during COP 26, parties established the Glasgow Dialogue to discuss arrangements for funding activities to avert, minimize, and address loss and damage.

Desanker concluded by pointing to opportunities to support adaptation through the Open NAP initiative, which is designed

to support least developed countries (LDCs), small island developing states (SIDS), and other developing countries in producing comprehensive NAPs, building on the best available science, data, and tools. He invited the GEO community to support vulnerability and risk assessments for specific countries.

Lorena Santamaria, WMO, noted that in many parts of the world, particularly in SIDS and LDCs, the lack of observations is often tied to the lack of local resources to pay for them. As a way of responding to the growing demand for weather and climate data, Santamaria highlighted three groundbreaking initiatives approved by the WMO Congress in October 2021: the [Global Basic Observing Network \(GBON\)](#); the [Systematic Observations Financing Facility \(SOFF\)](#); and the new [Unified Data Policy](#).

She explained that: GBON is designed to address observational coverage gaps; and SOFF would provide financial and technical assistance to SIDS and LDCs and focus on long-term generation and international exchange of basic surface-based observations.

Questions centered on how to access the best resolution imagery to make sure the best decisions are taken. On ways in which the GEO community can contribute to the Glasgow Dialogue, Desanker noted the need to support vulnerable communities to measure the degree of risk and the time it would take to recover from climate-related damage. Among areas of prioritization of climate actions, panelists highlighted: resilience building in SIDS; awareness and training on how to use GEO data; and supporting LDCs to develop climate change rationale for project development.

Climate and Ocean: On Wednesday, Maree Wilson, National Earth and Marine Observations, Geoscience, Australia, moderated this Anchor Session. Reflecting on COP 26, Peter Thomson, UN Secretary-General's Special Envoy for the Ocean, expressed "mixed feelings," but satisfaction with the outcome on the ocean-climate-nexus, which he said could be claimed as "a lasting legacy of COP 26." However, he noted disappointment with the last-minute watering down of language related the phaseout of coal. Pointing to the need for trillions of dollars to secure the ocean, he affirmed that only "through accurate and coordinated global observation will we obtain the science we need for the ocean we want."



Julian Barbière, IOC-UNESCO

Julian Barbière, Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO), highlighted the UN Decade of Ocean Science for Sustainable Development (2021-2030), which is centered on building the science-policy interface to help countries achieve the SDGs, especially on ocean health, as well as providing sound science needed to inform global climate policy frameworks, including the UNFCCC. On the ocean-climate nexus within the decade, he noted it is designed to address key knowledge gaps and provide opportunities for including ocean solutions in NDCs. He mentioned the deep ocean as one of the priorities in terms of understanding the climate services it provides.

Joanna Post, UNFCCC Secretariat, presented on climate and ocean in the UNFCCC process, noting that although the ocean is part of and a driver of the climate system, it has been largely ignored in the UNFCCC process until recently. She underlined the importance of the observation of ocean and coastal zones, and the need to strengthen observation and science to offer solutions and stimulate effective climate action. Post said efforts are ongoing to strengthen ocean action across the board within the UNFCCC, highlighting that, for instance, the Glasgow Climate Pact recognized the importance of ensuring the integrity of all ecosystems, including the ocean, and invites UNFCCC workstreams and constituted bodies to integrate the ocean under their work.

Laura David, University of the Philippines, presented on the [GEO Blue Planet](#) initiative and highlighted its work in supporting countries' NAPs under the UNFCCC. She cited the example of the initiative's activities in the Philippines, noting that it assists countries like hers identify their priorities and provides technical support for incorporating the ocean into NAPs.

Rosamond Bing, CEO, Ministry of Lands and Natural Resources, TONGA, reported on the outcome of consultations with Pacific Island Country and Territory representatives, aimed at improving the use of Earth and marine observation technology for national and regional sustainable development. This, she reported, catalyzed the decision to form the [Digital Earth Pacific](#) project, which makes satellite data available to inform policy and action at all levels.

During the subsequent discussion, panelists discussed knowledge gaps on some areas of the ocean and reported discrepancies in EO capacity between different regions. They further noted the need to focus more on the open sea, which is a larger carbon sink, than on inshore areas. Discussing ways of involving citizens, they noted the need to align adaptation to traditional knowledge systems and proposed promoting the useability of EO to support solutions to Earth's challenges.

Resilient Cities and Human Settlements: During this Anchor Session, held on Wednesday, Graham Alabaster, Chief, Geneva Office, UN-Habitat, provided an overview of his organization's work on cities, highlighting synergies with the New Urban Agenda, the SDGs, and GEO's work. He identified the [Earth Observations Toolkit for Sustainable Cities and Human](#)



Joanna Post, UNFCCC Secretariat

[Settlements](#) as an example of collaboration between UN-Habitat, GEO, and the EO4SDG initiative under the GWP.

Thuraya Al Hashimi, Executive Director, Digital Data Enabling Sector, Federal Competitiveness and Statistics Centre, UAE, presented on geospatial practices for sustainable development in her country. She cited the example of calculating national indicators with geospatial intelligence, such as using electricity and water meters as an input for estimating the population.

Shushanik Asmaryan, Center for Ecological-Noosphere Studies (CENS), National Academy of Sciences, Armenia, reported *in situ* measurements using unmanned aerial vehicles to assess land surface temperatures, and pollution in Yerevan City. Asmaryan presented on planting of green walls in the form of vines and creepers, as an NBS, aimed at safeguarding the health of children in over 160 kindergartens exposed to traffic-related pollution and extreme heat.

Cascade Tuholske, EO4Health, and Earth Institute, Columbia University, US, noted that urban extreme heat severely harms human health and wellbeing. He discussed conclusions of a [study on air temperature and humidity data from 1983-2016](#), showing that global urban extreme heat exposure increased 200% from 1983 to 2016.

Nazmul Huq, Head, Resilient Development Program, ICLEI World Secretariat, Bonn, Germany, discussed ICLEI's global support to local and regional governments through, among others, the [GreenClimateCities](#) programme, which provides guidance on analyzing, acting, and accelerating integrated climate action. He further reported on support for a unified reporting system to support local climate action.

During the ensuing discussions, a question centered on whether ICLEI proposes specific global datasets/tools, offered by the GEO community, to its cities. In response, Huq explained that the preference was for cities to use updated global datasets as far as possible. Another question related to the role of EO in anticipating hazard prone areas in urban settlements. A call was made for easy messaging and boiling down information so it could be absorbed easily, as well as considering the full urban/rural continuum to ensure smaller settlements receive requisite

information. Key identified priorities included the need for: a bottom-up solution space tied to local community development; common language and tools; adapting technologies and some of the solutions; and supporting and developing mechanisms like ICLEI.

Nature-Based Solutions (NBS): On Thursday, this Anchor Session put a spotlight on GEO's work on NBS to address societal challenges and mitigate ongoing environmental crises.

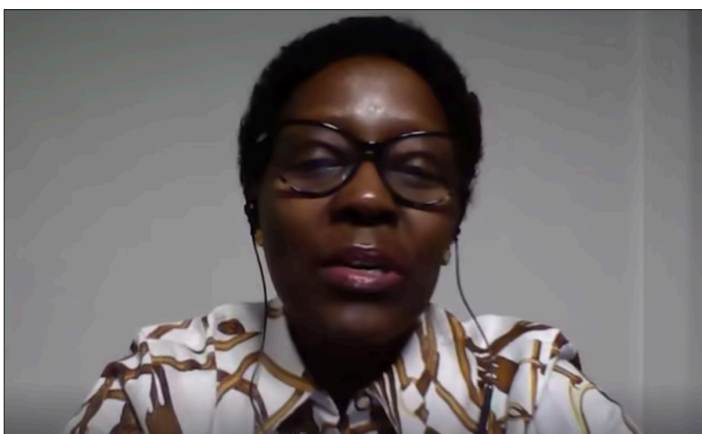
Moderator Daniel Juhn, Vice President, Moore Center for Science, Conservation International, set the scene, noting that NBS is established in, among others, indigenous and ecosystem approaches of environmental restoration.

Elizabeth Maruma Mrema, Executive Secretary, Convention on Biological Diversity (CBD), emphasized the need to apply EO to inform NBS and address the interconnected crises of climate change and biodiversity loss. She highlighted opportunities for the GEO community to contribute to the GBF discussions, as a provider of high-quality geospatial data that is required to improve data critical for NBS and for monitoring GBF targets and goals.

Titus Letaapo, Co-founder, GEO Indigenous Alliance, and Managing Director, Sarara Foundation, said NBS, traditionally part of indigenous community practices, have been eroded over time due to loss of cultural practices. He reported on his organization's work among rangeland communities in northern Kenya to revive practices such as: rotational grazing, which allows rejuvenation of pastures; tree planting; and reseeded of grasslands.

Mariá Londoño, Co-Chair of the [GEO Biodiversity Observation Network \(GEO BON\)](#), discussed the Essential Biodiversity Variables that were developed to capture data on biodiversity change useful for monitoring purposes and to guide decision-making processes and investments. She reported the increasing use of EO in NBS planning and assessment processes.

Antje Hecheltjen, German Agency for International Cooperation (GIZ), discussed how the [GEO Land Degradation Neutrality Initiative \(GEO-LDN\)](#) uses EO data to monitor the SDGs. Highlighting the linkages between the LDN and NBS concepts, she underlined that both aim to achieve healthy ecosystems, food security, and human wellbeing. She presented on GEO-LDN's support to national and local actors through, *inter alia*, capacity development, data quality standards, and data



Elizabeth Maruma Mrema, CBD Executive Secretary

analytics. Hecheltjen highlighted the Land Use Planning for LDN tool which helps stakeholders in the land use sector to make more transparent and informed decisions by promoting participatory land use planning processes.

Timothy Max Wright, Conservation International, presented on accounting for nature under the [Earth Observation for Ecosystem Accounting \(EO4EA\)](#) initiative. He explained that ecosystem accounting, a newly adopted standard by the UN Statistical Commission, is a standardized framework for linking the environment with society and the economy. He underlined that EO4EA seeks to further develop the application of EO to support ecosystem accounting consistent with the standards and guidelines set out by the UN System of Environmental Economic Accounting.

The panel discussion centered on several issues, including approaches required to gain community acceptance of NBS approaches such as setting aside land for conservation through national parks and reserves. NBS in an urban context was mentioned with green infrastructure cited as key for the movement of native species in cities. Participants exchanged views on barriers and opportunities to accelerate NBS globally, and the role that GEO BON could play in this. They called for synergistic approaches, harmonized data, and interoperable tools to avoid duplicating efforts.

The value of ecosystem accounting for human wellbeing was also addressed. Participants then considered research and development gaps and opportunities for the GEO community around data and knowledge interoperability. Other issues discussed included: integrating local and indigenous knowledge in EO; a federated approach consisting of "building blocks of harmonized datasets and interoperable tools and algorithms"; ecosystem accounting through a multilevel process; and how GEO can engage on the post-2020 GBF.

Pathways to Impact in Africa: On Thursday, this side event on "Pathways to Impact in Africa" highlighted the vital role of open, operational platforms for EO data and showcased the [Digital Earth Africa](#) and [Africa GeoPortal](#) platforms. Adam Lewis, Digital Earth Africa, described Digital Earth as a platform that uses EO to provide analysis-ready data to support policy and investment decisions. He explained it provides access to free and open data sets, and open-source tools that can be used by all to support achievement of the SDGs and other global policy agendas.

Pauline Okeyo, Esri, described Africa GeoPortal as a platform that provides geospatial data, tools for interacting with the data, and infrastructure for disseminating the data and content across Africa.

Youth Track

The Youth Track opened on Monday morning in a "town hall" format. Florian Franziskakis, GEO Secretariat, co-hosted the session, highlighting it as an occasion to bring together young people interested in EO and sustainable activities.

Welcoming participants to the meeting, Yana Gevorgyan, Director, GEO Secretariat, emphasized the need for reliable environment information underpinned by EO. She highlighted the role of young people in transformational change in order to achieve the kind of future envisaged, as well as the need to

integrate young voices so they are part of systematic agenda setting in GEO and to establish a youth CoP.

Nathalie Pettorelli, Senior Scientist, Zoological Society of London, discussed equality, diversity, and inclusion in the context of diversifying the GEO community by addressing barriers to inclusion. She highlighted the work of the GEO EDI Subgroup, aimed at supporting GEO as an institution that provides a fair, supportive, and encouraging networking environment. Pettorelli explained that generational diversity is one of the priorities of the subgroup as well as ensuring youth representation in GEO activities.

In the subsequent discussions moderated by Francis Omondi, New Partnership for Africa's Development/Africa Peer Review Mechanism (NEPAD/APRM) Kenya Secretariat, speakers considered how GEO is building leadership and advocacy within its work, engaging with different GEO communities, including the private sector and the possibility of internships with them supported by GEO.

Cross-Regional Dialogue Between the Americas and Africa: On Wednesday, Teopista Nakalema, FAO, discussed the use of EO data to monitor deforestation in Uganda, using satellite tools such as Landsat and Sentinel-2. Noting limited youth involvement in EO, she identified lack of capacity as a major reason for this. Nakalema called for capacity building, including through the GEO network, as well as the provision of youth networking opportunities. She highlighted the role of the Youth Track and called for it to be a regular event.

This was followed by an open discussion moderated by Gilberto Guevara, Puerto Rico Science, Technology and Research Trust, focusing on the establishment of a Youth CoP within GEO. Participants suggested:

- conducting human-centered design studies to determine how people access EO and better understand the opportunities and challenges with accessing and using these data and services;
- using social media to highlight opportunities for youth within GEO;
- connecting the CoP with GEO's thematic activities;
- leveraging on existing networks with active youth constituencies;
- involving youth in organizing events to bring in innovative ideas;
- tapping into mentorship from GEO communities to build capacity in the Youth CoP; and

- ensuring the CoP is driven by youth.

Steven Ramage, GEO Secretariat, suggested that bringing existing geospatial youth communities, notably young women, under a single EO youth banner via GEO could be very powerful and helpful for everyone.

Yana Gevorgyan noted many opportunities for youth to learn and share experiences and knowledge around the world and called for promoting linkages beyond the GEO community.

How Can GEO Be More Inclusive to Young People?

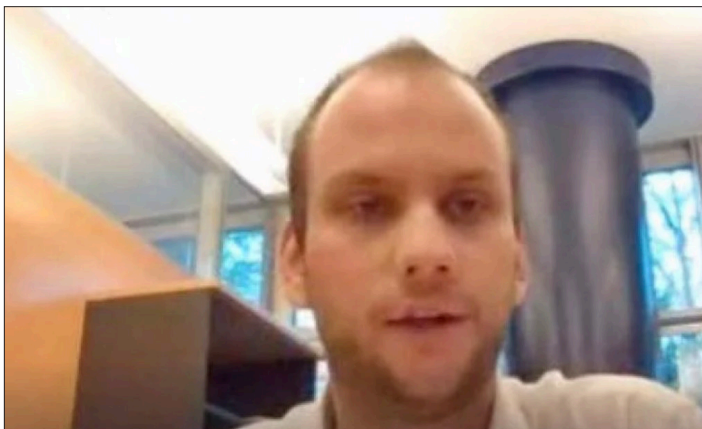
On Wednesday, Liliana Castillo Villamor, Aberystwyth University, UK, presented the Amigrow farming practice, which involves crop production using artificial intelligence, remote sensing data, EO, and crowdsourced data from farming communities. She noted that a Youth CoP has great potential for harnessing the abilities of youth in different sectors.

Amber Kremer, International Programs, US Geographical Survey, highlighted Mapathon Peru 2021, a project aimed at mapping the most vulnerable areas to disaster related events using PeruSAT-1 imagery. She explained that the exercise, which was sponsored by 12 private and public organizations in the Americas, entailed five days of mapping over 55 buildings, and 23 of the participating students were subsequently selected to take part in the GeoPathways Program. She noted that GeoPathways connects participants with professionals in their area of interest, develops knowledge and skills, conducts research using geospatial data and technologies, and applies knowledge in "real world" projects.

Son Do, University of Houston, US, introduced the CERES Web App, a citizen science approach monitoring reservoir operation from space for poorly gauged reservoirs. He said the aim is to overcome the discrepancy in the number of recorded reservoirs between global and local data and address overlapping management, lack of incentives, and technical barriers that limit data sharing.

Alma Meyer and Kailey Mohammed, Brigham Young University, US, presented work on validating the GEOGloWS-European Centre for Medium-Range Weather Forecasts Streamflow Services and application of these forecasts to create flood maps, predict reservoir levels, and forecast algae blooms.

Delali Kemeh, GEO Secretariat, moderated the open discussion after the presentations. Participants considered: the practical aspects of launching a GEO Youth CoP; how the GEO community can demonstrate willingness to engage young people;



Florian Franziskakis, GEO Secretariat



Gilberto Guevara, Puerto Rico Science, Technology and Research Trust

possible strategies beyond hackathons, such as social media; and engagement opportunities such as showcase weeks for youth.

Cross-Regional Dialogue Between Europe, the Commonwealth of Independent States and Asia-Oceania:

On Thursday, Delali Kemeh opened this dialogue, noting young people have demonstrated their enthusiasm for establishing a GEO Youth CoP aimed at providing opportunities for mentorship, networking, and experience sharing from youth.

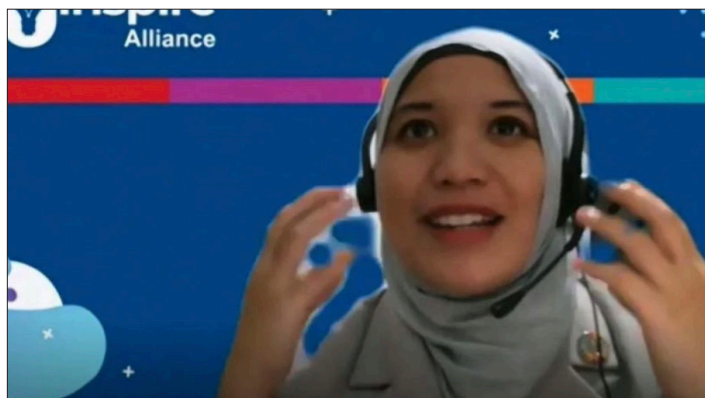
In a keynote address, Yan Liu, Chinese Academy of Sciences, sharing her experience as a young scholar working with GEO, said working with experienced China GEO researchers has enabled her refocus her own research questions. She also highlighted involvement in document translations, event organization, and research reporting. Presenting lessons learned while working on her research study on sustainable urban development, she said GEO provided unique connections between researchers and data users.

During the open discussion, Moderator Mikhail Fernandes, UNEP, urged youth to utilize UNEP's resources, including its training opportunities for youth.

Participants discussed, among others, benefits of working with senior and experienced GEO scientists for mentorship. They also noted the need for opportunities for youth involvement in addition to GEO Week and Plenaries.

Shushanik Asmaryan and Lilit Sahakyan, CENS, National Academy of Sciences, Armenia, provided an Armenian perspective on attracting, engaging, and transferring experience to young people. Lilit Sahakyan highlighted the center's activities based on multidisciplinary investigations in environment, ecology, food, and agriculture, applying innovative geographic information system (GIS) and remote sensing technologies. She highlighted the diversity of the multi-generational CENS team, the convivial working atmosphere, active knowledge exchange, good infrastructure, and opportunities for lifelong learning.

Shushanik Asmaryana highlighted various European- and US-funded projects which opened new opportunities for further development of research and innovation. She implored young people to "never stop dreaming," describing the world of GEO science as "a miracle" which fosters creativity and encompasses nature, the environment, space, technology, and innovation that can take them beyond the scope of knowledge and expand their imagination. She concluded by advising youth to act as a team in discovering the path to success, adding that the "hardest path has the fewest competitors."



Nuraini Rahma Hanifa, U-INSPIRE Alliance

Wrap-up and Launch of the Community of Practice: On Friday morning, Steven Ramage reflected on the Youth Track discussions over the week noting it has helped bring together youth from around the world, along with senior researchers, scientists, and policymakers, into a dialogue on the role of young people in GEO. Participants then gathered in breakout rooms to discuss: leveraging existing youth networks and links with GWP activities; promoting opportunities for internships and early career jobs under the GEO umbrella; and advancing youth inclusion in GEO events and highlighting their participation.

Nuraini Rahma Hanifa, U-INSPIRE Alliance, reported on breakout group discussions on leveraging existing youth networks and linkages with GWP activities, and regional GEOs. She highlighted suggestions to:

- liaise with GEO DRR-WG and CC-WG and to organize a hackathon to provide interested youth work on open data;
- develop mentorship internships using the model of Women in GIS Uganda in diverse areas, including geography, environment, water, agriculture, sanitation, and health; and
- involving youth engagement in addressing challenges of communities and to support enhancing community resilience.

Alex Mckee, Geospatial UK, reported from the breakout group on promoting opportunities for internships and early career jobs under the GEO umbrella, highlighting a proposal to create a GEO Early Career Researcher Network to promote EO jobs and internships. Participants also suggested, among others, shorter-term internships and training platforms.

Paul Ngozi Ojukwu, National Space Research and Development Agency, Nigeria, reported from the breakout group on advancing youth inclusion and participation in GEO events, highlighting proposals to integrate youth in the main events during the GEO Plenary meetings, and to create a joint plan of action between the Youth CoP and the Industry Track. Participants also suggested the CoP focus both on youth and young professionals.

Industry Track

The Industry Track met under the theme of Accelerating Action Through PPPs.

Day 1: Opening Ceremony: On Monday, 22 November, Master of Ceremonies Kamal Ramsingh, Chairman, ZASPACE, welcomed participants to the session, underscoring that partnerships have proven to be a real secret source of growth around the world.

In a video address, Yana Gevorgyan, Director, GEO Secretariat, highlighted the GEO partnerships comprising 140



Kamal Ramsingh, Founder, CEO, ZASPACE



Valrie Grant, Founder and Chairperson, GeoTechVision

organizations from the public, private, and civil society sectors. She emphasized PPPs as the way of the future, encouraging companies to enter into a dialogue with GEO on where to innovate and in what areas decision makers are looking for solutions.

Keynotes: Will Marshall, Co-Founder and CEO of Planet, highlighted EO satellite activities based on: “imaging the whole world, every day”; tracking changes; and making those changes visible, accessible, and actionable to move from awareness of effects to action based on data on a timescale relevant for human intervention. He noted data can, for example, help: farmers improve productivity and crop yields; manufacturers track supply chains; and governments track illegal deforestation.

Emmanuel Pajot, Secretary General, European Association of Remote Sensing Companies, discussed the benefits of EO across six parameters: economic, environmental, regulatory, entrepreneurship and innovation, science, and technology, and societal. He provided case studies of: mapping sea ice off Greenland; dredging in the Maldives; forestry management in Sweden; and water quality management in Germany and Spain.

Expert Speakers: Keith VanGraafeiland, Esri, presented on an Esri and GEO Blue Planet collaboration on developing an index for coastal eutrophication for all countries, which can be used to promote understanding and reduce coastal eutrophication. He explained that the methodology for the project is driven by satellite data which regularly measures chlorophyll concentrations at the surface of the ocean globally.

Valrie Grant, Founder and Chairperson of GeoTechVision, made the case for diversity in terms of fostering belonging and fairness, and its relevance to science, technology, engineering, and mathematics, as well as to the geospatial sector. She noted the business case for diversity is well documented with a proven correlation between profitability, and gender and ethnic diversity. She explained the pandemic has amplified pre-existing inequalities and is hitting emerging economies the hardest but has also underscored the need for accurate, timely, and comprehensive data.

Day 2: Opening and Keynotes: On Tuesday, 23 November, the Industry Track focused on partnerships. Albert Anoubon Momo, Vice President and Executive Director, Trimble, moderated the session. In a keynote presentation, Aila Raquel, CEO, Alya Nanosatellites Constellation, discussed hyperspectral data from nanosatellite constellation sensors. She highlighted a range of benefits including supporting sustainability of farming, mine exploration, oil and gas, clean energy, and environmental

protection. She noted the importance of partnerships for mutual growth and cited a range of space allies including StellarModal Transportation Association, which supports linking supply chains for space commerce.

Esther Ogbu, Samburg Geospatial, reported increased EO and geospatial technologies in Africa, which have seen a rise in, among others, minisatellites, continent-wide EO infrastructure, and the launch of the Africa GeoPortal. She highlighted benefits of this growth including increased employment, societal wellbeing, and active participation. Emphasizing the key role of PPPs, she discussed the prerequisites for developing geospatial industries, including political will, enabling legislation, and openness and transparency of data.

Leveraging PPP Panel: This session addressed evaluation and implementation of PPP business models in the EO sector. It was co-moderated by Satarupa Kapoor Director, Market Intelligence and Policy Advocacy, Geospatial Media and Communications, India, and Prashant Shukle, President and CEO, Global Geospatial Group. The session opened with two presentations.

Massimiliano Vitale, Planet, explained that across many industries, geospatial and EO data is critical to solve the toughest challenges. He noted the SkySat scans and detects meaningful change, then zooms in and takes images used for monitoring activities, such as illegal logging and detecting early signs of pests or disease. He highlighted an established subscription business model for sectors, including agriculture, defense, forestry, energy, finance, and insurance, and for plans to become a scaled commercial geospatial data company.

Gunter Schreier, Deputy Director, German Remote Sensing Data Center, provided a public side perspective evaluating implementation of PPP business models in the EO sector. He highlighted TerrSAR-X and TanDEM-X, the first German national civil synthetic aperture radar (SAR) satellites exploring the radar side of the electromagnetic spectrum through a PPP with Airbus Defence and Space, a commercial company.

In the ensuing discussion, presenters reflected on the nature of EO business models. Vitale explained that three factors converged: availability of different electronic components; ability to get into space often; and availability of powerful cloud computing techniques and processes. He outlined a model based on developing products that can be delivered in a streamlined fashion to a large number of actors, which differs from traditional, bespoke government procurement. Schreier stressed that PPP is not just about the government as the customer and industry as operator or service delivery



Yana Gevorgyan, Director, GEO Secretariat

provider but also entails involvement and collaboration from the beginning. He highlighted finance as an additional factor, noting the finance landscape for startups is more diverse with venture capital companies on board, for example, reducing reliance on government financing. The consensus was on the need for a multiplicity of actors to address environmental challenges quickly and collaboratively, which in some cases means PPPs are not an option, but a necessity.

Funders Panel: This session focused on investment and venturing in the downstream space value chain. Rick Dunn, CFO, Satellogic, explained why space startups have difficulty raising funds. He said space startups are often trying to do something that has never been done before and convincing investors of their team's ability to execute those activities can be hard. He underlined that, for investors, there is a fine line between investing too early or too late, and the challenge is convincing investors they are in the "sweet spot." Dunn also urged entrepreneurs to focus on de-risking their business models.

Mike Sage, CEO, Structured Finance Solutions, First National Bank, South Africa, clarified that banks provide a wide range of capital a bit further down the risk spectrum than venture capitalists. He said banks want companies that: generate profitable cash flows; have a good management team; are in good markets; and have good prospects. He concluded that for startups, banks may not be the best fit, as banks are often looking for more mature companies to invest in.

Deven Govender, CEO, Lion Pride Investment Holdings, underlined the importance of startups' founding teams, stressing that investment companies want founders that have a good track record. He explained that investment companies are generally unwilling to take on market risk and said founders must do proper market research to ensure the market viability of their products. He said they can do this by defining their hypothesis, developing "minimum viable tests," and testing them in the market.

Company Profiles of Featured SMMEs: On Monday and Tuesday, a total of 16 SMMEs presented their company profiles and work on EO.

Peter Baumann, Founder, Rasdaman, presented raster data manager, consisting of a massively scalable, federated, Big Datacube Analytics engine. He noted unprecedented global demand for various types of analytics, better workflows, and automated imagery analysis.

Katia Stambolieva, Founder, Cosmos Pics, presented her company's satellite imaging platform. She said the platform is a "no code" do-it-yourself way of obtaining and analyzing satellite

imagery, which can, for instance, be used to track water use, and understand how environmental regeneration and restoration is taking place.

Dietrich Heintz, CEO and Founder, Cropix, described his company's web GIS platform for presenting map productions. He explained the company specializes in SAR data and uses optical data as reference.

Juan Peña Ibáñez, CEO and Cofounder, Orbital EOS, explained that his company focuses on detecting, characterizing, and forecasting oil spills from space through an EOS Viewer, which is a digital platform designed to be a one-stop-shop for oil spill monitoring and reporting.

Feng Wenhui, Guangzhou iMapCloud Intelligent Technology Co. Ltd., introduced her company as a high-tech enterprise dedicated to the research and development of geospatial intelligent products, providing ultra-low altitude drone remote sensing network operation services and industry solutions. She highlighted the intention of becoming the world's leading ultra-low-altitude drone remote sensing service provider by building 500,000 base stations and deploying 1,000,000 drones.

Saurabh Channan, CEO, terraPulse, said his company leverages cloud computing, machine learning, and years of experience in developing remotely sensed products to provide measurable and quantifiable insights about Earth's terrestrial surface. He highlighted the terraView platform as a visualization tool for quickly assessing and interacting with data.

Eldrige de Melo, Satellogic, explained that his company builds small satellites to democratize access to satellite imagery, and offers artificial intelligence solutions for planetary scale insights and dedicated satellite constellations, among others.

Hilda Manzi, Director and Co-Founder, Geospatial Research International, presented on the Cost of Land and Wetland Degradation (COLWED) Tool, intended for valuation modeling in the ecosystem valuation decision-making processes.

Joel Cumming, Chief Technology Officer, SkyWatch, described EarthCache as a simplified way of purchasing commercial satellite images, intended to be a "one-stop shop" for this purpose.

Roxane Bandini-Maeder, Co-CEO and Co-Founder, Geoneon, highlighted her company's role in EO and advanced analysis for anticipating the impact of climate-related disasters. She explained the process involves: automated land-use segmentation; hazard susceptibility classification; and exposure and vulnerability calculation.

Mark Matthews, Founder and CEO, CyanoLakes, highlighted "Your Weather App" for lakes, aimed at protecting public health with free and open information from satellites. Outlining its features, he mentioned that cyanobacteria health risks and pollution levels can be detected and any lake worldwide can be added. He also introduced the CyanoLakes Web Application, which provides actionable information for decision making and operational tasks for water professionals.

Gurvinder Chohan, CEO, AQST Canada Inc., provided a company overview focusing on satellite, spacecraft, and propulsion systems manufacturing. He discussed monitoring activities for: crop health and yield forecasting; refugee movements; and infrastructure development in conflict areas. He also highlighted insurance modeling to inform risk exposure models to increase efficiency and profitability.

Aditya Agrawal, Founder, D4DInsights, described his company's work in supporting the establishment of Digital Earth



Peter Baumann, Founder, Rasdaman

programmes by providing operational data infrastructure that can be deployed locally or in the “cloud.” He explained this infrastructure is hosted, managed, and operated by the region which the infrastructure is meant to support and is responsive to the priorities of the countries in that region.

Kim Partington, CEO and Co-Founder, Geocento, explained that his company leverages the power of imagery for enterprises, by giving large organizations and institutions access to global networks of satellites to address whatever problems they may have. He described the platform EarthImages, which aggregates images from different suppliers and provides a way to request fresh collections from image providers.

Jie Bai, Alibaba Cloud, China, presented AI Earth, which is providing remote sensing data services to more than 200 countries around the world to predict disasters and to monitor weather patterns and forest cover, among others. She highlighted how the China Meteorological Professional Service Cloud is working with Alibaba Cloud to monitor weather data for weather risk management and strengthening multi-channel release of meteorological disaster warning information.

Gaetano Volpe, Founder, Latitudo 40, said his company is facilitating climate action through the Urban Data Analytics Platform, a fully automated urban sustainability solution to help organizations transform environmental and social goals into action. The platform, he noted, helps cities improve sustainability by enabling analysis of environmental trends and causes, identifying risks and priority areas for action, and formulating action plans. He further reported that the Latitudo 40 carbon credits marketplace is helping companies buy cities’ carbon credits to finance sustainability projects.

Upcoming Meetings

Ocean Carbon from Space Workshop: This workshop is being organized by the European Space Agency and the Plymouth Marine Laboratory, with support from NASA. The main objective of the workshop is to bring together remote sensing scientists, field scientists, and modelers around the common topic of ocean carbon, its pools and fluxes, its variability in space and time, and the understanding of its processes and interactions with the Earth system. **dates:** 14-18 February 2022 **location:** virtual **www:** oceancarbonfromspace2022.esa.int/

2022 GEOAquaWatch Meeting: The goal of the GEO AquaWatch Initiative is to develop and build the global capacity and utility of EO-derived water quality data, products, and information to support water resources management and decision making. It will hold its biennial meeting in March 2022. **dates:** 22-24 March 2022 **location:** Delft, the Netherlands **www:** www.geoaquawatch.org/event/2020-geoaquawatch-meeting/

Global Conference on Space for Emerging Countries 2022: This conference is being organized by the International Astronautical Federation to: create awareness on the essential legislative and policy elements that must be considered in establishing a firm foundation for national or regional space programmes; and promote the creation and development of a local space industry that is connected and integrated to the global space industry. **dates:** 16-20 May 2022 **location:** Quito, Ecuador **www:** www.iafastro.org/events/global-series-conferences/the-global-conference-on-space-for-emerging-countries-2022/

Living Planet Symposium 2022: Organized by the European Space Agency, this symposium will focus on how EO contributes to science and society, and how disruptive technologies and actors are changing the traditional EO landscape. **dates:** 23-27 May 2022 **location:** Bonn, Germany **www:** lps22.esa.int/frontend/index.php?folder_id=4254&page_id=

International Astronautical Congress 2022: The Congress will take place on the theme “Space for @ll” and aims to reach beyond the space community, to bring together all communities to offer opportunities for networking and forging new contacts and potential partnerships. **dates:** 18-22 September 2022 **location:** Paris, France **www:** www.iafastro.org/events/iac/iac-2022/

GEO Week 2022: GEO Week 2022, including the 18th GEO Plenary, will take place in October 2022. **dates:** 31 October - 4 November 2022 **location:** TBC **www:** www.earthobservations.org/index.php

For additional upcoming events, see sdg.iisd.org/

Glossary

CoP	Community of Practice
COP 26	26th session of the Conference of the Parties
DRR	Disaster risk reduction
EO	Earth observations
GBON	Global Basic Observing Network
GEO	Group on Earth Observations
GEO BON GEO	Biodiversity Observation Network
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
GWP GEO	Work Programme
LDCs	Least developed countries
LDN	Land degradation neutrality
NAPS	National adaptation plans
NBS	Nature-based solutions
NDCs	Nationally determined contributions
PPP	Public-private partnership
SIDS	Small island developing states
SDGs	Sustainable Development Goals
SMMEs	Small, medium and micro-sized enterprises
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WMO	World Meteorological Organization