

Draft Report of GEO-17

This Document is submitted to Plenary for decision.

Tuesday, 23 November 2021

1 OPENING SESSION

1.1 Welcome from Lead Co-Chair

Joanna Drake, GEO Lead Co-Chair (European Commission, DG Research and Innovation), welcomed participants to this first virtual Plenary in GEO's history.

1.2 Opening Remarks (Prerecorded)

In opening remarks, GEO Co-Chair Zhang Guangjun (China) proposed a "Shared Future for All" at the Convention on Biological Diversity Conference of Parties. Guangjun noted China is opening access to 30 Earth observation (EO) datasets for sustainable development during GEO Week, and he 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. He cited the example of support to the Thai Flood Disaster Response through satellite post-disaster data.

GEO Co-Chair Mmboneni Muofhe (South Africa) noted that GEO has accomplished most targets set for the year. He lauded GEO's efforts in strengthening regional work, welcoming 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 and demonstrates that continued partnerships through the GEO community are the key to achievements.

GEO Co-Chair Stephen Volz (United States), highlighted increased recognition of GEO's ability to provide good data to meet the objectives of, among others, the UN Agenda 2030 for Sustainable Development, the Paris Agreement on Climate Change and the Sendai Framework for Disaster Risk Reduction, and that progress towards achieving these global arrangements was not possible without informed information from EO. He concluded by stating that GEO was at a critical junction following the Mid-Term Evaluation (MTE).

Yana Gevorgyan, Director, GEO Secretariat, observed that Plenary is the arena where progress is demonstrated and policy-relevant insights, critical connections with end users and other stakeholders can be highlighted. She called on GEO Principals to take note of the significant progress in the GEO Work Programme and other engagement activities and take the necessary action to facilitate connections across communities at national and local level to accelerate the uptake of the results by decision makers. She concluded by thanking GEO Principals for their support in seeking a GEO mandate under the United

Nations Framework Convention on Climate Change (UNFCCC), and emphasized that the MTE report lays groundwork for post-2025 GEO.

1.3 Opening Keynote Presentation

GEO Lead Co-Chair for 2021, Joanna Drake, European Commission (EC), praised GEO Members for progress in strengthening engagement with UN bodies, citing recognition by UNFCCC at the 26th Conference of the Parties (COP26). 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 noting that the 'Eyes on Earth' have yet to reach their potential and should play a more active role in supporting the GBF. Looking to the future, she outlined several milestones still to come, such as taking stock of the MTE and lessons learned, accelerating research to operations, increasing focus on user-oriented approaches, and further exploring the way in which national systems are integrated into GEOSS. She concluded by noting that GEO should proactively and collaboratively work with developing countries towards the promotion of equality, diversity and inclusion.

1.4 Welcome New Participating Organizations and Associates

The Secretariat introduced the new Participating Organizations and Associates that have joined GEO this year:

- Participating Organizations:
 - The Consortium of Universities for the Advancement of Hydrologic Science, Inc (CUAHSI);
 - The UN Educational, Scientific and Cultural Organization (UNESCO);
 - International Centre on Global-Scale Geochemistry (ICGG);
 - The International Research Center on Karst (IRCK);
 - The Open Source Geospatial Foundation (OSGeo);
 - The Inter-Islamic Network on Space Sciences and Technology (ISNET);
 - The World Geospatial Industry Council (WGIC).

Total number of GEO Participating Organizations: 140.

- Associates:
 - Research Centre for Toxic Compounds in the Environment (RECETOX).
 - D4DInsights.
 - Planet.

Total number of GEO Associates: 19.

1.5 Approval of Agenda and Draft Report of GEO-XV Plenary

Plenary approved the Agenda and draft Report with no modifications.

1.6 Mid-Term Evaluation Report and Executive Committee Response

Due to time constraints, Justyna Nicinska, Chair of the MTE Team was not able to provide the MTE presentation to Plenary. Muofhe introduced the Executive Committee response to the GEO Mid-Term Evaluation 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; 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 that 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 GEO Work Programme, he said that 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 MTE 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.

Plenary approved the Executive Committee Response to the 2021 GEO Mid-Term Evaluation Report.

2 GEO WORK PROGRAMME ACTIVITIES AND CONTRIBUTIONS TO GLOBAL POLICY FRAMEWORKS

2.1 Setting the Stage

This session showcased activities in GEO Work Programme (GWP) that are closely linked to global policy agendas, notably those that have reached a significant level of maturity, as well as identifying the ones that have high potential to reach such recognition. GEO's engagement priority areas include the 2030 Agenda for Sustainable Development, Climate Change - Greenhouse Gas Monitoring and Disaster Risk Reduction. Recently, Resilient Cities and Human Settlements in support of the New Urban Agenda was recognized as a fourth GEO engagement priority and more generally GWP activities address other major policy frameworks, such as the Convention on Biological Diversity, the Minamata Convention on Mercury, the UN Convention to Combat Desertification and the Ramsar Convention on Wetlands. The success of GEO activities providing key services to these frameworks depends on significant support from Members (funding, dedicated teams, GEO Secretariat support), the existence of an active user community, as well as operational data and services. Growth and success in this area, as well as the potential to create impact depends on continued investments, including by GEO Members.

2.2 Panel Presentations

Anthony Rea, WMO, moderated the panel discussion on successful GWP 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, 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.

Key points:

GOS₄M responds to increasing policy demands to:

- Answer key health and environmental issues related to mercury pollution;
- Assess effectiveness of measures undertaken by parties to the Minamata Convention to reduce risk for human health and the environment; and
- Provide global data sets of comparable monitoring data by harmonizing existing regional and global scale networks and assessing the effectiveness of measures undertaken.

Sarah Barsotti, Icelandic Meteorological Office, highlighted the successful experience of using observational data for volcanic civil protection as part of the Geohazards Supersites and Natural Laboratories (GSNL) initiative. She explained that civil protection authorities in Iceland have collaborated with the scientific community for past decades through a Scientific Advisory Board. In a crisis, 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.

Key points:

- Volcanic eruptions (Iceland) often imply a large economic, social, cultural and political impact (on both local and international scales);
- Iceland was declared a permanent geohazard supersite in December 2013;
- As part of a GEO Supersite, with access to open high-quality data, scientists can offer advice to those taking decisions, leading to an increase in societal benefits.

Amir Givati, Chief Science Officer, EnviroManager, Israel, discussed the GEO Global Water Sustainability (GEOGloWS) initiative. 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 sustainable development goals (SDGs), especially SDG 6 (access to water and sanitation), and also promotes equality, as all countries within the region have access to the same hydrological forecasts.

Key points:

- Transboundary basins between the Palestinian Authority, Israel and the Gaza strip call for coordinated management;
- GEOGloWS streamflow forecast system used by local authorities in Israel and Gaza to make decisions during flooding emergency;
- Forecast provided by international agencies is trusted by all parties, building cooperation in the region and add value beyond climate and hydrology.

Lisa Maria Rebelo, Vice Chair, Scientific and Technical Review Panel, Ramsar Convention on Wetlands, highlighted that many countries have wetlands but that most countries do not address wetlands in their nationally determined contributions (NDCs) to 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.

Key points:

- It is not possible to achieve global biodiversity, climate change or SDGs without addressing wetlands;
- The Ramsar Convention provides a framework for agreement and for actions based on wetlands to achieve agendas;
- GEO Wetlands provides knowledge base, integration across thematic areas, and co-creation for end-user oriented tools and services.

2.3 Session Outcomes and Recommendations

- Reference GEO Mid-Term Evaluation Findings 5, 6, 7.

The GEO community has a role to play in translating data and understanding the need for specific tools/products for institutions to unlock financing; also, private sector companies and platforms, such as Google Earth Engine and Amazon Web Services play a critical role. Private sector companies will focus on cost-effective and accurate EO tools, which provide both reliable data with historical information, suitable resolution data, and forecasting; however, there is a gap on asset-level data.

Access to finance for developing countries is another challenge: strengthening the climate rationale with historical EO and climate data is part of the contribution that the GEO community can provide.

There is an overall need for the GEO community to provide baseline data for climate investors on all sectors for project pipelines, investments, risk assessment and Monitoring Evaluation Accountability and Learning (MEAL).

Baseline data will be critical for the development and implementation of National Adaptation Plans (NAPs), including by providing asset-level data (ecosystems, housing, etc.) and overlapping risk forecasts and recovery times. Comprehensive asset data is required to move beyond a country-level related discussion.

Call to GEO Principals:

- ***Provide links to appropriate national government agencies to benefit from the achievements of these and other GWP activities.***

Wednesday, 24 November 2021

3 ENGAGING THE GEO COMMUNITY

This session showcased GEO's efforts to promote the science-policy interface by engaging various stakeholders including policymakers and users in the GEO Community.

3.1 Regional GEOs

Regional GEOs shared their needs, good practice, lessons learned and ideas for future collaboration, as well as their efforts to engage national level operational agencies, such as statistical agencies, agriculture, forestry, and water.

Evangelos Gerasopoulos, Research Director, National Observatory of Athens (NOA), Greek GEO Office moderated the session on engaging the GEO community for strengthening the science-policy interface. The session started with a panel discussion on good practices and lessons learned from engaging policy and user communities through the Regional GEOs and thematic Working Groups.

Phoebe Oduor, AfriGEO Secretariat, Regional Centre for Mapping of Resources for Development (RCMRD), highlighted the joint work of AfriGEO and the GEO-LDN Initiative in Ghana and South Africa in the context of land degradation neutrality (LDN), which entails combating desertification, restoring degraded land and soil and striving to achieve a land degradation neutral world by 2030. She highlighted the emerging collaboration among academia and land planners through establishing three working groups on capacity building, data quality standards and data analytics, 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 difficulty in engaging governments for policies to connect different institutions in order to work together and share resources.

Angelica Gutierrez, AmeriGEO, National Oceanic and Atmospheric Administration (NOAA), highlighted the AmeriGEO collaboration with a variety of partners, including national and local governments, NGOs, private sectors, international agencies and consortium (i.e. UNDRR, FAO, UNDP, GEF, OGC, SIMOCUTE) on designing: a modeling system for natural capital accounting in Costa Rica (as a part of the GEO-GEE cloud license programme); a remote-sensing based indicator of crop stress and drought conditions in Argentina; and a high-resolution multi-hazards studies based on environmental fragility index and climate change in Guatemala and Puerto Rico. She noted that collaboration and strengthening of national GEOs has positively impacted the region in terms of capacity development and investment in Earth observations in the various countries.

Toshio Koike, Executive Director, International Centre for Water Hazard and Risk Management, Japan, presented on behalf of AOGEO on its Asian Water Cycle Initiative (AWCI) in cooperation with the Data Integration and Analysis System (DIAS). He explained the AWCI is building a nationwide network and decision-making platform on water resilience and disasters in Myanmar, Sri Lanka and the Philippines. Toshio provided an example of the network in the Philippines in involving 12 relevant ministries (i.e., DRR management council, public works, agriculture, environment, statistics) plus regional and local governments, civil societies and academia under an international mandate set up by UNESCO, WMO, UNDRR and United Nations University (UNU). He emphasized that such a network is effective in promoting the use of integrated data and risk assessment to make operational impacts (on flood warning and evacuation orders by National Meteorological and Hydrological Services (NMHS) and local governments) and policy contributions (i.e., NAPs and national and local DRR plans).

Thierry Ranchin, Director, Centre Observation, Impacts, Energy, Paris School of Mines, on behalf of Europe's regional GEO (EuroGEO), discussed a science-policy interface example at the national level in France. The work was driven by a policy question from the French Government to the French electrical transmission system operator about how to reach carbon neutrality by 2050, which raised scientific questions about the appropriate climate 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.

Key point:

- Regional GEOs are effective in engaging various stakeholders including policy makers and user communities and thus important for implementation of knowledge products (e.g., NAP guidance), linking action from regional to national as well as to local levels and vice-versa.

3.2 GEO Working Groups (CC, DRR, CD)

This session showcased notable outcomes and key plans for GEO's work in the areas of climate action, disaster risk reduction, and capacity development.

Allison Craddock, GEO Capacity Development WG Co-Chair presented results of the ongoing cross-Working Group mapping of the GEO Work Programme and reported that almost half of GEO Work Programme activities focus on the three GEO engagement priorities: Paris Agreement, Sendai Framework and the UN 2030 Agenda. GWP mapping analysis indicates opportunities and potentials to engage Regional GEOs for scale-up and increased cross-WG collaborations for integrated assessment and implementations under overarching themes, such as Nature-based Solutions (NBS), Resilient Cities.

Lucia Perugini, Co-Chair of GEO Climate Change WG, presenting milestone events, reported on the GEO Climate Policy and Finance Workshop held in September 2021 which contributed to identifying the unique role of GEO to support climate action. The workshop also launched a new Climate Finance workstream in GEO to be developed beginning in 2022. Furthermore, she explained GEO's contributions to climate services, exemplified in the inclusion of the Global Wildfire Information System (GWIS) and GEO Global Water Sustainability (GEOGloWS) in recent editions of the WMO State of Climate Services report. She also highlighted the recent launch of the joint report "GHG Monitoring from Space: A mapping of capabilities across public, private and hybrid satellite missions" for mitigation, and ongoing work on climate adaptation to support National Adaptation Plans (NAPs) with technical guidance, as well as GEO's efforts to obtain a mandate under the UNFCCC on providing EO-based knowledge products to support Parties' action on climate.

Reporting on GEO participation at UNFCCC COP26, she noted that for the first time since 2007, GEO was mentioned in the Research and Systematic Observation (RSO) negotiation conclusions, resulting in a recognition of GEO with reference to partnerships, biosphere observations, EO-related products, indicators and applications, and that this is a first step to seeking a mandate for GEO to provide regular input to UNFCCC negotiations.

Kene Onukwube, Co-Chair of GEO DRR-WG, noted that the DRR-related GWP activities are 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 UN-GGIM WG Disasters, to be launched at UNDRR Conference in May 2022 and how it is designed to provide government decision makers with a concise summary of EO Tools and services in dealing with DRR at country level; thus, supporting GWP activities to be better connected with policy makers and users.

Key points:

How to encourage science-policy interface:

- Useful for thematic GWP activities and Regional GEOs to reach out to technical experts (with bottom-up approach) as well as policy makers (with top-down approach); both approaches are important;
- In terms of the top-down approach, 3 elements are key in building a network of government agencies (who are EO data providers, users, and funders): 1. an international mandate through the UN, agreed/endorsed by the heads of states (who then ask relevant ministers to work together), 2. Continuous institutional support in implementation, e.g. capacity building; 3. Ready-to-use EO products;
- Regional GEOs can be the interface between local/regional policy makers and users to collect their needs, to be tailored to the regional elements;
- To work with local communities, it is important to involve various stakeholders (e.g. governments, NGOs, media, academia) and to provide integrated data on hazards, exposures, and socio-economic vulnerabilities for integrated risk analysis;
- Regional GEOs can work with national GEOs by complementing their existing national efforts based on ongoing/new programs; Regional GEOs can bring in GEO's thematic flagship/initiative activities to support national agendas;
- GEO WGs work with Regional GEOs in implementations of EO knowledge products, such as the GEOGLAM's NAP guidance as Regional GEOs have experiences in involving national GEOs and building networks. Following the GEOGLAM's example, GWP activities can also develop guidance documents in coordination with Regional GEOs.

3.3 Fourth Engagement Priority - Resilient Cities and Human Settlements

Eleni Myrivili, Chief Heat Officer, City of Athens, Greece, noted that 50% of the global population are living in urban settlements, this trend will continue and so it is important for cities to build resilience to be able to survive and thrive. She pointed out the importance of urban resilience in coping with social-economical stress (i.e. unemployment, poverty, refugees, infrastructures) and chronic shocks and integrated risks (multiple occurrences of heat waves, floods, fires, drought and/or poor air quality) accelerated by climate change. Using Athens as an example of a densely populated city with the worst heatwave in the summer of 2021, she highlighted the use of EO analysis in updating Athens Resilience Strategy for 2030, looking at geospatial correlations among green areas, temperature, the percentage of children and income distributions.

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 proposed GEO's 4th Engagement Priority to 1) engage cities and stakeholders to understand needs; 2) help them understand the value of EO for human settlements; 3) continue assisting the implementation of the New Urban Agenda in collaboration with UN-Habitat; 4) give visibility to GWP activities, 5) exploit existing and develop new EO-based tools and services, 6) create synergies within GEO engagement priorities and trigger collaboration between regional GEOs including with individual GWP activities. Participants approved "Resilient Cities and Human Settlements" as GEO's fourth engagement priority supporting the New Urban Agenda.

Plenary then adopted the Fourth Engagement Priority, Resilient Cities and Human Settlements.

3.4 Session Outcomes and Recommendations

Reference GEO Mid-Term Evaluation Finding 5, 6, 9, 11.

Thematic WGs to collaborate with each other and with GWP activities for integrated assessment using multi-hazards, socioeconomic and geographic data and implementations under overarching themes, e.g., nature-based solutions, Resilient Cities and Human Settlements (formally endorsed as GEO's 4th engagement priority), integrated approach for DRR and climate adaptation.

WGs and Regional GEOs to encourage GWP activities and national GEOs to work together in creating or improving EO tools/services and guidance documents to help countries both at policy and technical levels.

Call to GEO Principals:

- ***Consider working with Regional GEOs and key international organizations to reach out effectively to national/regional/local governments and support their interactions with various stakeholders (e.g., academia, international organizations, media, and NGOs).***

Thursday, 25 November 2021

4 BRIDGING THE DIGITAL DIVIDE WITH DATA, TOOLS AND KNOWLEDGE

This session highlighted GEO's efforts to promote full and open access to Earth observation data and implement the GEO Data Sharing Principles (DSP) and good practices in data sharing, as well as showcase the development of local, nationally relevant services through access to new technologies and platforms. Joanna Drake, European Commission, introduced this session emphasizing the importance of ensuring data is available to support decision making in a manner that is open and analysis-ready.

4.1 Bridging the Digital Divide with Data, Tools and Knowledge

Several GEO activities served as use cases to demonstrate the importance of ensuring all enabling conditions for achieving GEO's vision, to empower GEO Members to use Earth observations for informed decision making. This vision can be accelerated by the adoption of a culture of open knowledge through implementation of Data Sharing Principles (including links to FAIR and CARE) and Data Management Principles (DMP), achieving legal interoperability among data licenses used by major providers of open data, development of analysis-ready data, and producing results in a reproducible format. These use cases also demonstrated good practices regarding in situ data sharing (substantiating Data WG's in situ data strategy) and use of the GEO Knowledge Hub and cloud services as means of providing access to data, information, and knowledge across the world to bridge the digital divide and promote global equity.

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 modelling, and tracking and coordinating responses to disasters. Open data helps nations to monitor, manage, and mitigate hazards, disasters and catastrophes. She noted that a downstream effect of the Digital Divide is that researchers who lack adequate internet connectivity often cannot share their data reliably. This is problematic for two reasons: (1) that data becomes isolated; and (2) researchers in those regions must rely on data collected by outside institutions and interests. This practice undermines the right of local communities to data self-determination, and can result in extractive exploitation, including data colonialism and data feudalism.

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 on 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 providing a GWIS user perspective, noted current gaps include nations, institutions and agencies that do not have the physical capacity to access the data (internet access, computing capacity), nor the institutional capacity to process and use the data (technical staff to perform data transformation and create products, research capacity to adapt and refine data transformation fit for purpose). GWIS bridges the digital divide in countries where there is a lack of institutional and physical capacity to access and use EO data in an effective way through applications that support data access, processing and use.

Omar Seidu, Ghana Statistical Service, described the Digital Earth Africa programme, an operational service which performs data transformation and creates products and research capacity to adapt and refine data transformation fit for purpose for the whole continent. He emphasized that Digital Earth Africa 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 Apamprama Forest Reserve in Ghana impacted by illegal mining and charcoal burning, where mapping of 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, provided an overview of the GEO Global Network for Observations and Information in Mountain Environments (GEO Mountains). They highlighted the GEO Mountains 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 its outputs, such as the Inventory of In Situ Observational Infrastructure, which is an online inventory and web-mapping application. Discoverable, accessible, and usable data – of multiple types, and from various sources – is critical to meeting objectives of the Initiative. Working in a collaborative way across traditional disciplinary, methodological, and geographic boundaries is equally important as data and software availability, and the applications developed that assist with policy response, are being packaged for inclusion in the GEO Knowledge Hub (GKH).

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 availability of raw data far exceeds the ability to analyse and generate insights and ensure uptake of such insights into policymaking; integrated analysis of Earth observation data and censuses/surveys helps overcome these issues and enable better monitoring of development indicators. The GEO-Amazon Web Services (AWS) cloud credits grant provided the project with the required computing power to do so.

During the discussion, participants addressed a range of issues, including extending the use of the Global Wildfire Information System data, obstacles to open data sharing and how to overcome them. Additionally, whether data from 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. Selma Cherchali (CEOS Chair 2022) noted that Analysis Ready Data (ARD) has been a major focus of CEOS over the past several years, in recognition of the increasing demands from users for quick and efficient answers to real-world problems. There are currently two CEOS Analysis Ready Data for Land (CARD4L) compliant datasets available (Landsat Collection 2 Surface Reflectance and Surface Temperature), with an additional seven under development. With increasing interest from the private sector, the availability of CARD4L datasets from both institutional and private providers is expected to rise significantly in the future and participation of the broader GEO community will be vital going forward.

Joanna Drake (EC) summarized the session by noting that several presentations put the spotlight on the recurring challenges that GEO like many other organisations is still facing in terms of access, use and reuse of data. These use cases will also demonstrate good practice regarding in situ sharing and use of the GEO Knowledge Hub and cloud services. Ideally as means of providing access to data, info, and knowledge across the world to bridge the digital divide and promote global equity. Organisations and countries were invited to consider how they can advocate for a culture of open knowledge.

Key points:

- The multiple issues highlighted in this session (capacity, infrastructure, data sharing/management, knowledge sharing, etc.) need to be addressed concurrently in order to make optimal use of EO in the advancement of societal benefits.
- Open data allows Public Private Partnerships to thrive, facilitates research with special communities and stakeholders, and fosters scientific research (especially when FAIR-compliant);
- The private sector can provide data that exceeds in quality/quantity what is available publicly, and many organizations may be willing to share data for sustainable development and related applications. However, there are issues with respect to protection of intellectual property rights (IPR), so the question is: what degree of adherence to GEO DSP is sufficient?

4.2 Open Knowledge Statement

Marie-Francoise Voidrot, European Director, Open Geospatial Consortium (OGC), provided the context, process and a summary of the GEO Open Knowledge Statement, explaining that it is more aligned with GEO Vision and Mission and Canberra Declaration to provide results orientated, evidence-based information for decision making. She noted that the new statement emphasizes not only the concept of open science but open access, citizen and participatory science, open data, software and hardware; diversity of knowledge and overarching goals of open knowledge.

Plenary adopted the GEO Open Knowledge Statement.

4.3 Session Outcomes and Recommendations

DWG needs greater participation from geographic regions other than Europe and North America.

DWG is conducting a Data Analysis Survey to better understand how the GEO DSP and DMP are adopted and used in the GWP activities, as well as where gaps may exist. Initial responses to the Survey indicate the vast majority of the GWP activities are keen to start their contribution in the GKH.

Capacity Building efforts within GEO should place greater emphasis on GEO DSP and DMP.

DWG to complete mapping analysis of FAIR, TRUST and CARE Principles against the GEO Data Sharing Principles (DSP), to determine to what extent they are encompassed by the DSP as well as enable GEO Members and GWP activities to better position themselves with respect to the principles.

DWG will also consider how the Open Knowledge Statement could be supported by Open Knowledge Principles.

Call to GEO Principals to

- ***Align activities with GEO Open Knowledge Statement and build open knowledge principles into national data programmes;***
- ***Support dissemination of open knowledge through the GEO Knowledge Hub.***

Friday, 26 November 2021**5 LOOKING AHEAD**

GEO Co-Chair Stephen Volz (US) took over from Co-Chair Joanna Drake (EC) as Lead GEO Co-Chair, and chaired the remainder of the Plenary.

Stephen Volz (US) opened the session thanking Joanna Drake and Patrick Childs (both EC) for their leadership of the GEO ExCom for 2021. He provided an overview of the session.

5.1 Finance and Budget

Brian Cover, Chief, Finance Division, WMO, presented the GEO 2020 Financial Statement and Audit Report. He reported an increase in voluntary contribution pledges to GEO in 2020 compared to 2019, and 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.

The Plenary then approved the Financial Statement and Audit Report.

Lawrence Friedl, Director of Applied Sciences, National Aeronautics and Space Administration (NASA), US, and member of GEO Budget Working Group, presented the 2022 GEO Trust Fund Budget, noting its adoption by the GEO Executive Committee. He outlined that the expected cash expenditure for 2022 is CHF 5.6 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 also promote it among their networks.

China expressed its intention to contribute to the GEO Trust Fund and participate in the Pledge Campaign. The EC 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, and expressed the country's intention to continue supporting the network of mercury observations across the region, anchored in South 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.

The Plenary then approved the budget.

5.2 GEO Awards

The GEO Awards Ceremony comprised:

- the GEO SDG 2021 Awards, which were launched in 2019 and led by the EO4SDG initiative. These awards recognize institutions, organizations, and countries that are applying EO towards the achievement of the SDGs;
- the GEO Individual Excellence Awards, which were launched in 2019 by the GEO Programme Board and celebrate individuals whose work is making a positive impact in improving the planet through EO; and
- the first ever GEO Art Competition organized under the theme “Mother Earth, I See You, I Hear You, I Feel You.” 49 entries in total were received from 26 different countries from Peru to Morocco, Ghana, Sri Lanka all the way to South Korea. The

youngest artist was 7 years old (Athit Kid from Thailand) and the oldest artist was over 60.

5.2.1 *The categories and winners of the GEO SDG 2021 Awards were:*

- Sectoral Category Awards:
 - GEO Member Country: Colombia and the United Arab Emirates;
 - Intergovernmental: UN Development Programme (UNDP) Colombia, UNDP Ecuador and UNDP Peru;
 - SDG Custodian Agency: Food and Agriculture Organisation (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, University of Twente, and United Arab Emirates Federal Competitiveness and Statistics Centre.
- Special Mention:
 - Inspiring Hope for Youth: International School of Milan / Viola Mascarucci

5.2.2 *The GEO Individual Excellence Awards winners were:*

- Brian Killough, NASA, US;
- Nataliia Kussul, Space Research Institute, National Academy of Sciences and State Space Agency of Ukraine;
- Guoqing Li, Chinese Academy of Sciences, China; and
- Stella Mutai, World Food Programme, Kenya.

5.2.3 *The GEO Art Competition winners were:*

- Yunchen Yu (China),
- Klara Maisch (US),
- Tara Illgner (US),
- Emilia Novikova (Switzerland),
- Philip Samartzis (Australia),
- Grayson Cooke & 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 (US), and
- Bernard Dissanayake Methuki Nethma Sanindi (Sri Lanka).

5.3 GEO Equality, Diversity, and Inclusion Statement

Nathalie Pettorelli (UK), GEO Programme Board presented the GEO Equality, Diversity, and Inclusion (EDI) Statement, which was developed by the EDI Subgroup formed in early

2020 in order 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 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.

GEO South Africa noted that the statement focus on inclusivity will have positive impacts on GEO activities. GEO China reported measures to support women to play a greater role in science and technical innovation. The European Commission urged that language diversity be strongly considered.

The Plenary then endorsed the EDI Statement.

5.4 GEO Work Programme 2023-2025

Andiswa Mlisa (South Africa), Programme Board Co-Chair, presented the GEO Work Programme 2023-2025, which will be approved by 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 GWP 2023-2025 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 the GWP categories; and simplification of the Implementation Plan template. The PB noted that there are many parts of the MTE report that are relevant to the GWP and to the PB. It recognized that the Executive Committee was preparing a response to the MTE report for presentation to the GEO-17 Plenary. The PB agreed that it would give further consideration to how to address the evaluation findings and recommendations in its work following the Plenary.

The EC appreciated the emphasis on open knowledge and increased collaboration and called for additional efforts to simplify the implementation process. The UK welcomed attention on 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 the GWP activities in the designing Impact Plans to enable impact-oriented approaches in the GWP.

5.5 Programme Board Members 2022

Craig Larlee (GEO Secretariat) presented the Executive Committee slate of nominations for the vacant positions on the Programme Board for 2022, consisting of GEO Members: Finland, Ghana, South Africa, the United Kingdom and the United States; and GEO POs: Committee on Space Research, Eurisy, Mountain Research Initiative, Open Geospatial Consortium and Plan4all. The Plenary approved the slate of nominees.

5.6 Executive Committee Members 2022

Yana Gevorgyan (GEO Secretariat Director) announced the composition by Caucus of the Executive Committee for 2022, as follows:

- for Africa: South Africa, Ghana and Senegal, with South Africa as Co-Chair;
- for the Americas: the United States, Costa Rica and Peru, with the United States 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.

Stephen Volz, US Co-Chair takes over the Lead Co-Chair role from the European Commission.

5.7 Review of GEO Week 2021 and Next Steps

GEO Lead Co-Chair Stephen Volz (US) provided remarks summarizing the activities of the Plenary week, reflecting on how beneficial it is to meet, even virtually, to review and confer on the work of our global community. He highlighted linkages from the Plenary discussions to the comprehensive response to the MTE, which will allow GEO to continue building on our successes while addressing our challenges and forging a path towards an action-oriented GEO post 2025.

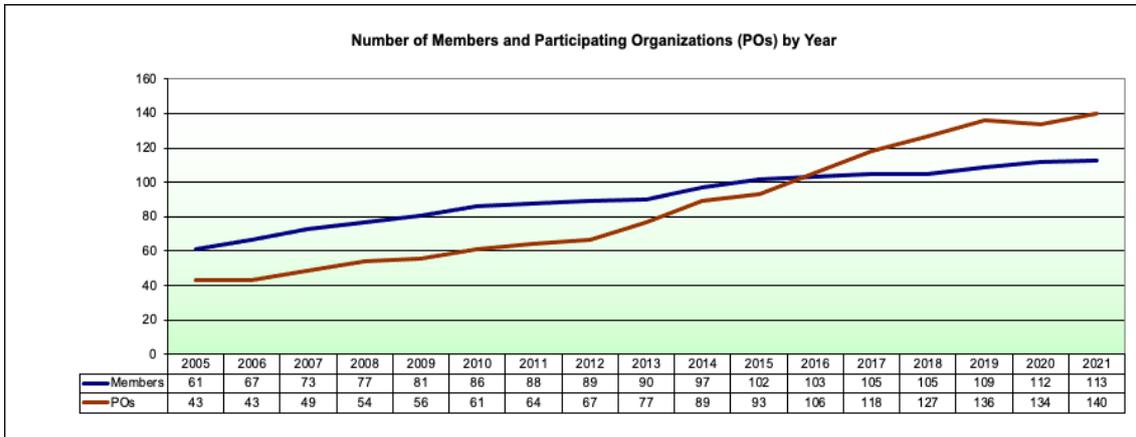
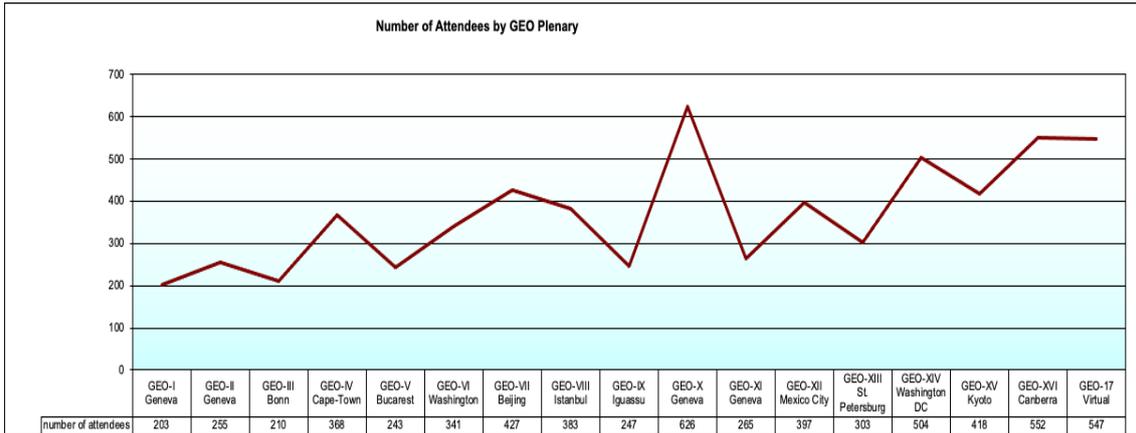
Douglas Cripe (GEO Secretariat) presented an overview of Plenary and Anchor Sessions including the discussions undertaken during GEO Week 2021, together with key action points from the meetings.

5.8 Announcement of GEO Week 2022

Yana Gevorgyan (GEO Secretariat Director) 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.

Draft List of Participants

Detailed list of GEO-17 delegates not available due to the online nature of the meetings.



ANNEX A

Anchor Sessions

1 INTEGRATED IMPLEMENTATION OF GEO WORK PROGRAMME ACTIVITIES

This session considered among others the importance of integration, synergies and cooperation in the work of the GEO community for the implementation of the GWP.

Sean de Cleene, Member of the Executive Committee of the World Economic Forum (WEF), 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 of GEO Global Agricultural Monitoring (GEOGLAM) Initiative said that 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 work programme.

Estefania Puricelli, GEOGLAM, presented a case study of the Paraguay-Parana basin, where agricultural production, transportation, energy production and markets have operated in silos to the detriment of the highly 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 Parana 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. A demonstration of horizontal data integration using Terria open-source tool was done for this region looking all together at hydrology, biodiversity, wetlands, agriculture, energy, climate, cities and disasters risk.

James Verdin, Famine Early Warning Systems Network (FEWS NET), US Agency for International Development (USAID), explained that FEWS NET monitors and mitigates food insecurity (in Africa and Central America) by providing actionable, evidence-based analyses to program food assistance. He emphasized the need for a multidisciplinary approach as flooding is becoming as important as drought on food insecurity because of climate change, highlighting collaboration with GEOGLAM on the 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 Europe's contribution to the Global Earth Observation System

of Systems (GEOSS), aimed at bringing together EO resources in Europe with e-shape. He also highlighted e-shape tools for integrated implementation of the GEO Work Programme and co-design of integrated activities.

Key points:

- Need for further integration across the GEO Work Programme to fully unlock the power of EO to address complex interlinked challenges;
- Connections between the SDGs, climate adaptation, DRR, and urban goals and targets should take advantage of synergistic relations, limit possible trade-offs and accelerate transformational change;
- Opportunity exists to access multiple government agencies through GEO Members.

2 CLIMATE ACTION

The session built on the conversation initiated at the GEO Climate Policy and Finance Workshop in September 2021 and discussed ways in which EO can strengthen public and private spending decisions by governments, financial institutions and businesses for climate-friendly investments.

Robert Bradburne, Deputy Chief Scientific Adviser, Department for Environment, Food and Rural Affairs (Defra), UK, moderated the 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, presented the role and climate-related activities of the US utilizing EO with a whole-of-government approach and urged the GEO community to maintain focus on open sharing and delivering of 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, Head of Geospatial, 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, Deputy Director of External Affairs, Green Climate Fund (GCF), presenting 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 in order to access climate financing. EO plays a critical role in de-risking investments, and leveraging a better balance on private financing beyond adaptation, leading to a new paradigm shift in how to utilize finance.

Paul Desanker, Manager, UNFCCC Secretariat, provided an overview on supporting national climate action on adaptation through National Adaptation Plans (NAPs), which reduce vulnerability to impacts of climate change and help coordination activities in the country. He highlighted efforts to move towards a more 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 UNFCCC COP26, Parties established the Glasgow Dialogues to discuss arrangements for funding activities to avert, minimize and address loss and damage. COP26 also established a new 2-year work programme aiming to review the Global Goal on Adaptation through the Global Stocktake and facilitating the establishment of robust M&E systems, monitoring progress on NAPs.

Desanker concluded by pointing to other 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 stools. He invited the GEO community to support vulnerability and risk assessments for specific countries.

Lorena Santamaria, Senior Programme Officer, 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 then 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.

Key points:

- EO can be used to strengthen spending decisions by governments and international financial institutions on climate-friendly investments in context of Paris Agreement;
- EO and other geographic sensors can help augment reporting practices and provide market transparency without requiring companies to measure climate-related risks;
- Financial decision makers are looking for new insights; GEO + technology can influence what, and how, climate is measured;
- GEO community invited to provide baseline data for climate investors on all sectors, to support project pipelines, investments, vulnerability and risk assessments for specific countries, building on regional and global scientific efforts.

3 CLIMATE AND OCEAN

This session investigated GEO Work Programme activities that are well positioned to provide inputs to country efforts to develop ocean/marine-conscious climate action, with particular focus on climate adaptation measures.

Maree Wilson, Branch Head, National Earth and Marine Observations, Geoscience, Australia moderated the session.

Reflecting on COP26, Peter Thomson, UN Secretary-General's Special Envoy for the Ocean, expressed “mixed feelings”, but satisfaction with the outcome on the ocean-climate-nexus front, which he said could be claimed as “a lasting legacy from COP26.” However, he noted disappointment with the last-minute watering down of 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, Head of Marine Policy and Regional Coordination Section, Intergovernmental Oceanographic Commission of 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 that 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, Programme Officer, UNFCCC Secretariat, presented on climate and ocean in the UNFCCC process, noting that although the ocean is part of the climate system and is a driver of the climate system, it has been largely ignored in the UNFCCC policy process until recently. She underlined the importance of 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, Professor and Director, Marine Science Institute, University of the Philippines, presented on the GEO Blue Planet Initiative and highlighted its work in supporting countries' NAPs under the UNFCCC process. She cited the example of the initiative's activities in her country, the Philippines, and explained that robust community ownership for climate action requires data at resolutions relevant to community scale; she also underlined that GEO Blue Planet assists countries like hers in identifying 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 consultative dialogues of the Pacific Island Countries and Territories (PICTs) representatives on 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, a regional programme that 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 for mitigation, which is a larger carbon sink than on inshore areas, while coastal zones are critical for adaptation efforts. 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.

Key points:

- Accurate and coordinated global observations are critical to support action on oceans;
- Regarding the 10 Ocean climate challenges of the UN Decade for Ocean Science, the role of the GEO community should be on providing access to data to monitor current status, long-term risks and develop adaptive capacities, focusing on the different scales of application and adaptation;
- The Ocean-climate nexus can help identify opportunities for including ocean solutions in Nationally Determined Contributions to the Paris Agreement;
- The link between Climate and Ocean communities on a policy/UNFCCC level could be strengthened through a framework across the two areas. With the further recognition of the ocean-climate dialogue at COP26, there was the ask for national governments to start collaborating across departments, and develop a strong scientific basis;
- PICTs need EO to assess climate change risks, especially sea level rise and extreme rainfall events;
- GEO Blue Planet has potential role in supporting NAPs as well as blue carbon mapping for NDCs, and UN Decade of Ocean Science.

4 RESILIENT CITIES AND HUMAN SETTLEMENTS

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 Settlements as an example of collaboration between UN-Habitat, GEO and the EO4SDG initiative from the GEO Work Programme.

Thuraya Al Hashimi, Executive Director, Digital Data Enabling Sector, Federal Competitiveness and Statistics Centre, Abu Dhabi, United Arab Emirates, 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, 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 a nature-based solution (NBS), aimed at safeguarding the health of children in over 160 kindergartens exposed to traffic-related pollution and extreme heat.

Cascade Tuholske, EO4Health, 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 though among others, the Green Climate Cities program 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 that it could be absorbed easily, as well as considering the full urban/rural continuum to ensure that 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.

The next step is to set up the Resilient Cities and Human Settlements Working Group (RCHS WG) for the 4th engagement priority. This will include existing members of the Urban Resilience Sub Group and other invited parties. The goal is to develop the Terms of Reference to incorporate aspects from this session, as well as include feedback from the engagement plan presented to the GEO Programme Board and Executive Committee respectively.

Key points:

- Not all activities presented are in the GEO Work Programme. With the 4th engagement priority newly approved, there is an opportunity to build on the existing engagement plan for resilient cities and human settlements to incorporate some of these activities, while at the same time increasing links with other engagement priorities;
- The implementation of the SDGs are a cross sector collaboration, which includes the public and private sectors, civil society, NGOs and international organizations;
- GEO has particularly been a strong collaborator for urban activities through the EO4SDG (Earth observation for SDGs), Human Planet Initiative, Global Urban Observations Initiative as well as CEOS (Committee on Earth Observation Satellites);
- Earth Observations Toolkit for Sustainable Cities and Human Settlements as an example of collaboration between UN-Habitat, GEO and the EO4SDG Initiative.

5 NATURE BASED SOLUTIONS (NBS)

This 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, CBD Executive Secretary, 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 post-2020 global biodiversity framework discussions, as a provider of high-quality geospatial data that is required to improve data critical for NBS and for monitoring targets and goals of the framework.

Titus Letaapo, Co-founder, GEO Indigenous Alliance, and Managing Director, Sarara Foundation, said NBS that have been 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 of northern Kenya to revive practices such as rotational grazing, which allows rejuvenation of pastures; tree planting and reseeded of grasslands.

Maria Cecilia Londoño Murcia, Co-Chair of 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 (GEO-LDN) Initiative 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 well-being. She presented on GEO-LDN's support to national and local actors through, inter alia, capacity development, data quality standards and data analytics. Hecheltjen highlighted the Land Use Planning for Land Degradation Neutrality tool which helps stakeholders in the land use sector to make more transparent and informed land use 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 is a newly adopted standard by the UN Statistical Commission and is a standardized framework for linking the environment with society and the economy. He underlined that the EO4EA Initiative 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 (SEEA).

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 the cities. Participants exchanged views on barriers and opportunities to accelerate NBS globally, and the role that the GEOBON 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 well-being 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 a post 2020 biodiversity framework, and outputs to be shared with the CBD Secretariat.

Key points:

- Emphasis on need to apply Earth observations to inform NBS and help tackle the interconnected crises of climate change and biodiversity loss. (Elizabeth Maruma Mrema, Convention on Biological Diversity (CBD) Executive Secretary);
- Opportunities for GEO community to contribute to discussions on post-2020 global biodiversity framework, as providers of high-quality geospatial data required to monitor the framework’s targets and goals;
- Several potential links for collaboration across GEO Work Programme exist (e.g., GEO BON, EO₄EA, GEO-LDN, GEO Indigenous Alliance).

ANNEX B

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 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 and the need to integrate young voices so that they are part of systematic agenda setting in GEO and to establish a community of practice.

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 Equality, Diversity and Inclusion 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 the 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.

1 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 & Research Trust, focusing on establishment of a youth community of practice 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 community of practice with GEO’s thematic activities;
- leveraging on existing networks with active youth constituencies;
- involving youth in organizing events in order to bring in innovative ideas;

- tapping into mentorship from GEO communities to build capacity in the youth community of practice; and
- ensuring the community of practice is driven by youth.

Steven Ramage, GEO Secretariat, suggested that bringing the 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 added that there are many opportunities for youth to learn and share experiences and knowledge around the world and urged for promoting linkages beyond the GEO community.

2 HOW CAN GEO BE MORE INCLUSIVE TO YOUNG PEOPLE?

Liliana Castillo Villamor, Aberystwyth University presented the Amigro 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 United States Geographical Survey, highlighted the 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 were mapped and 23 students were selected to participate in the GeoPathways Program. She noted that the 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 CERES Webb-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, Utah, US, presented work on validating the GEOGloWS ECMWF 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; possible strategies beyond hackathons, such as social media; engagement opportunities such as showcase weeks for youth.

3 CROSS-REGIONAL DIALOGUE BETWEEN EUROPE, THE COMMONWEALTH OF INDEPENDENT STATES AND ASIA-OCEANIA

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

In a keynote address, Yan Liu, Chinese Academy of Sciences sharing her experience as a young scholar, working with GEO, said that working with experienced China GEO researchers has enabled her to 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 training opportunities for youth.

Participants discussed among others benefits of working with senior and experienced GEO scientists for mentorship, and also noted the need for opportunities for youth involvement besides GEO Week and plenaries.

Shushanik Asmaryan and Lilit Sahakyan, Center for Ecological-Noosphere Studies, National Academy of Sciences 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 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 Europe 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, which can take them beyond the scope of knowledge and expand their imagination. She concluded by advising youth to act as a team, discover the path to success, adding the “hardest path has the fewest competitors.”

4 WRAP-UP AND LAUNCH OF THE COMMUNITY OF PRACTICE

On Friday morning, Steven Ramage reflected on the Youth Track discussions over the week noting that it has helped bring together youth from around the world along with senior researchers, scientists and policy makers 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 discussions in the breakout group on leveraging existing youth networks and linkages with WGP Activities, and Regional GEOs. She highlighted suggestion to:

1. liaise with GEO DRR-WG and Climate Change Working Group and to organize a hackathon to provide interested youth work on open data;
2. develop mentorship internships using the model of Women in GIS Uganda in diverse areas including geography, environment, water, agriculture, sanitation and health; and

3. involving youth engagement in addressing challenges of communities and to support enhancing community resilience.

Alex Mckee, Geospatial UK, reported from the breakout 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 on advancing youth inclusion and participation in GEO events highlighting proposals to integrate youth in the main events during the GEO plenary sessions, and to create a joint plan of action between the Youth CoP and the industry track committee. Participants also suggested that the CoP focus both on youth and young professionals.

