

Draft Report of GEO-XV

This Document is submitted to Plenary for decision.

Draft Report of GEO-XV

31 October – 1 November 2018

Kyoto, Japan

Wednesday, 31 October 2018

Meeting convened at 09:00 am at the Kyoto International Conference Center.

1 Opening Session

Chair: Mmboneni Muofhe, Deputy Director, General Science and Technology, Department of Science and Technology, Republic of South Africa.

1.1 Welcome from Japan

Ms Keiko Nagaoka, State Minister of Education, Culture, Sports, Science and Technology (MEXT), warmly welcomed all delegates to Japan and the Kyoto International Conference Center. She stated that it was an honour for Japan to be hosting the GEO week, noting that the United Nations Framework Convention on Climate Change (UNFCCC) 3rd Conference of Parties (CoP) had adopted the Kyoto Protocol in the same venue, under Japan's leadership in 1997. Thus it was only fitting that the GEO-XV Plenary, which aims at contributing to solutions in response to various global challenges, including climate change, be held in Kyoto.

Ms Nagaoka went on to observe that the world is being gripped by a growing sense of crisis regarding the sustainability of the environment. Environmental problems are arising in many places around the world, and human activity is becoming increasingly identified as being responsible for the deterioration, impacting the lives of nearly everyone on a daily basis. Within this context, we must all take action as "global citizens" to tackle the various global issues that

cannot be solved by any single country alone, with the help of GEO in providing the Earth observations necessary to help meet these challenges.

She noted that, from the beginning, Japan has been a strong supporter of GEO as an international platform for dialogue on Earth observations. Japan intends to contribute further to the development of GEOSS through increasing data sharing from its observational satellites such as GOSAT-2 (successfully launched at the beginning of the week), as well as the Japan Data Integration and Analysis System (DIAS), an Earth environmental information platform for creating knowledge to solve global problems and generate socio-economic benefits. With policy makers, researchers, end-users and other stakeholders coming together during GEO Week 2018, Ms Nagaoka anticipated that discussions and interactions would lead to greater utilization of Earth observation data and information, and ultimately contribute to the realization of the Sustainable Development Goals (SDGs), the Paris Agreement, and the Sendai Framework for Disaster Risk Reduction. She expressed the wish that GEO Members and Participating Organizations would strengthen their ties, particularly as a result of the GEO-XV Plenary, and further shape the role of GEOSS in solving global issues.

Ms Nagaoka concluded by observing that Japan will be hosting the 2019 Rugby World Cup as well as the 2020 Olympic and Paralympic Games, and hoped that many participants would return for these events. She then expressed her sincere appreciation to the GEO Secretariat Director and the GEO Secretariat for their great efforts in planning the GEO-XV Plenary, and to all attendees for their active participation in the meeting.

1.2 Opening Remarks

Lead Co-Chair Mmboneni Muofhe, Republic of South Africa, thanked the government of Japan for hosting the GEO-XV Plenary, and expressed his gratitude to his fellow GEO Co-Chairs who are making sure that GEO continues to push forward with the objectives agreed upon last year in Washington DC. He also thanked the GEO Members and Participating Organizations for making GEO the great organization that it is. He noted that, even though still quite new, he appreciated the fact that the Secretariat Director has jumped right in to the position and made a commitment to steer the organization forward. He thanked the GEO Secretariat team for their support, as well as the previous GEO lead Co-Chair, Stephen Volz (USA), who paved the way for smooth transition in Co-Chair leadership.

Mr Muofhe noted that the GEO community had been pushing forward on GEO's strategic objectives as agreed to during the GEO-XII Plenary and Ministerial in 2015, and had been working hard towards successful implementation of the 2017-2019 GEO Work Programme. He highlighted recent activities that demonstrated a

commitment to advocating open access to Earth observations globally, engaging with stakeholders and private sector, and delivering data and services to inform decision-making. He confirmed that these will continue to be the primary goals for GEO over the coming years, especially as they pertain to each of the priority global policy areas. And while the Plenary provided an occasion to celebrate achievements, GEO must also focus on challenges at hand which included preparations for the 2019 GEO Ministerial and a revised, augmented role for the Regional GEOs. Citing AfriGEOSS as an example, he saw its ambition as encompassing a continued effort to mobilize membership across the Africa while emphasizing the central role Earth observations should play in decision-making across the continent. He concluded by challenging Plenary to renew its commitment to a results-orientated Earth observations system of systems, contributing to the resolution of global challenges.

Co-Chair Wei Huang, Vice Minister, Ministry of Science and Technology of China, People's Republic of China, welcomed all delegates and expressed his sincere gratitude to the Japanese government for hosting the GEO-XV Plenary, and offered congratulations on the successful launch of GOSAT-2 the past Monday. He also thanked Stephen Volz for his hard work as the Lead GEO Co-Chair the past year, and welcomed the new faces, Co-Chair Mr Patrick Child (EC) and Secretariat Director Mr Gilberto Camara.

Mr Huang believed that this Plenary was an important event for the implementation of GEOSS Strategic Plan, noting that over 2018, the structure of GEO had been improved, making it a broader and more inclusive community; its Membership base had strengthened; engagement with international organizations had increased; and the GEO Work Programme activities aiming at the GEO engagement priorities had been effectively promoted. He further observed that the past year had witnessed the prosperous development of regional GEOs, citing the substantial progress made by AOGEOSS thanks to concerted efforts of its 21 members and relevant international organizations. Milestones included the first AOGEOSS International Conference that was held in China in May, and the Mekong River Basin Pilot Study Project that was launched at the conference. Also, three AOGEOSS training sessions were held in China, Nepal, and Laos earlier in the year, while the GEOSS Asia-Pacific Symposium had been successfully held the previous week.

Mr Huang noted that China had further integrated domestic Earth observation resources over the past year through promotion of "China's Plan for Implementing GEOSS", including the launch of 25 Earth observation satellites which further enhanced the integration observational data, their application and service capability, from a variety of platforms. He further informed Plenary that China had been making progress towards GEO's three priorities:

- The government had promoted ecological progress, with cities and towns including Deqing being selected as examples for a quantitative evaluation on the implementation of the UN 2030 SDGs in China;
- China had taken climate change into account in the national medium- and long-term planning for economic and social development, demonstrating responsibility of a large country in climate governance;
- The government promoted TanSat data sharing to the world, and thus the utilization of meteorological and oceanic satellites for monitoring key factors in climate change;
- The China GEOSS-DSNET, an Earth observation data sharing platform, provided satellite data for worldwide disaster relief, such as Hurricane Gita in the South Pacific, dam burst in Laos, and earthquake and tsunami in Indonesia, illustrating China's commitment to Disaster Risk Reduction globally.

Mr Huang confirmed China's commitment to uphold the concept of openness, inclusiveness and win-win cooperation, and support Earth observation capacity building in Asian countries such as Cambodia. Focusing on the application requirements of Africa, China had strengthened cooperation in land cover mapping and in-situ validation with Kenya, Madagascar and other countries through the Global Ecosystems and Environment Observation Analysis Research Cooperation, which has been operational for the past 7 consecutive years.

He concluded by wishing the Plenary every success, noting that a bright future will result from concrete actions taken today, and stated that China stood ready to work together with all GEO Members and Participating Organizations to create a better future.

Co-Chair Patrick Child, Deputy Director-General, Research and Innovation, European Commission (EC), welcomed all delegates to GEO-XV Plenary and thanked the Japanese hosts for their generous and gracious hospitality. He noted that, like Japan, the EC was a founding member of the GEO initiative, which traced its origins to the first Earth Observation Summit held in 2003. On a broader level, the EC attached great importance to Research and Innovation cooperation with Japan. This was highlighted in the EU-Japan Strategic Partnership Agreement, signed in July 2018.

Mr Child further observed that the EC has been a major supporter of GEO and GEO-related research and innovation since 2005, and the EC is willing to go on supporting GEO into the future. However, he believed that a major turning point regarding GEO has been reached. It is already almost five years since Ministers' meeting in Geneva decided to commit to GEO for a second decade and a full three years since the Ministerial launching the detailed Strategic Plan. In other words,

GEO is no longer in a transition or preparatory phase for the real thing: we must now see an impact from our efforts and investments.

On the occasion of that GEO Ministerial, governments affirmed that GEO and its Earth observations and information will support the implementation of, the 2030 Global Goals for Sustainable Development, the Sendai Framework for Disaster Risk Reduction 2015-2030, and the United Nations Framework Convention on Climate Change. In twelve months' time, we are planning to convene another GEO Ministerial in Australia to take stock of progress. At that point, GEO must demonstrate it is actually delivering, so that it is at the forefront of the minds of those in need of information for decision-making. Indeed, the need for information derived from Earth observations has never been as great as our economies and societies are driven by information. GEO has a unique opportunity to facilitate the use of Earth observations by governments, the commercial sector, researchers and by citizens.

Mr Child emphasized that the success of GEO can only be measured by its relevance based on deliverables, which support areas high up on the political agenda. This is imperative as we face ever-increasing demands to deliver a response on climate issues and the wider Sustainable Development Goals. Impressive progress has been made by GEO in supporting the three GEO engagement priorities more needs to be done to cope with the urgent situation we are facing. Nothing can better illustrate this urgency than the special report emerging earlier this month from Intergovernmental Panel on Climate Change on "1.5°C impacts and pathways". He viewed this as a wake-up call for all governments, with the main message being that stabilizing the global temperature at 1.5 degrees warmer than pre-industrial levels is still possible but requires immediate and focussed action. Earth observations can and do play a major role. GEO should be able to put this at the very top of its agenda and deliver. The EC is committed to supporting a prompt, concerted and coordinated strategy on reducing greenhouse gas emissions in time for the forthcoming COP meeting.

Mr Child commented that he was very much looking forward to the dedicated panel discussions on the Paris Agreement, the Sustainable Development Goals and the Sendai Framework Agreement. He believed that these three GEO priority areas were well chosen and were deserving of GEO's urgent attention. He added that the European Union had been actively contributing to the user-oriented approach through a number of different programmes including Copernicus and Horizon 2020 – the world's largest publicly funded research and innovation funding programme. A proposal for Horizon 2020's successor - Horizon Europe – is well advanced and the EC is proposing to continue to support GEO actions in particular and environmental observation in general. He further observed that over the past year the GEO regional initiatives had really taking off, manifested in

Europe with many organisations having committed to the EuroGEOSS initiative with a real enthusiasm to cooperate, combine and coordinate to create a connected playing field in the world of Earth Observation in Europe and beyond. The focus of EuroGEOSS has been squarely on the end-users and addressing their needs. He pointed out that the strengthening of these activities in the regions should not be seen as a threat to the Global Earth Observation System of Systems but rather as an asset. While more focussed on the issues in its own geographical area, each regional initiative is contributing to the overall effort as the problems we face are global ones.

In closing, Mr Child invited all participants to visit the European stand at the exhibition where a sample of the many contributions to GEO/GEOSS was being presented by projects, Participating Organizations and European GEO Members as well as the Copernicus Programme.

Co-Chair Stephen Volz, Assistant Administrator for Satellite and Information Services, national Oceanic and Atmospheric Administration (NOAA), United States of America, thanked the government of Japan on behalf of the US delegation for hosting the GEO-XV Plenary and welcoming everyone to Kyoto. He congratulated the Japan Aerospace Exploration Agency (JAXA) as well as the Ministry of the Environment and the National Institute for Environmental Studies (NIES) on the successful launch of GOSAT-2 (Greenhouse gases Observing SATellite-2) "IBUKI-2" (meaning "breath"), which promises to provide observations of greenhouse gases, such as carbon dioxide and methane, with higher levels of accuracy through even higher-performance on-board observation sensors than GOSAT-1 ("IBUKI") launched almost ten years ago.

He commented that 2018 had been an active year for many in the GEO community, and that it had been a personal privilege to serve as the Lead GEO Co-Chair, which offered the opportunity to interact with many parts of GEO and participate in the efforts that shaped this year. Reflecting on the work over the past year, he was pleased with some of the milestones accomplished, which included:

- A change in the organizational leadership as Barbara Ryan passed the baton of GEO Secretariat Director to Gilberto Camara in July, noting that after a smooth transition, Mr Camara had stepped into his role with vigour, bringing a renewed focus to the GEOSS and GEO's Flagships and Initiatives, to deliver information and services with the greatest impact to society.
- The GEO 10-year Strategic Plan adopted in 2015 emphasized the importance of understanding user needs and recognized that while global observations, information and services can be collected and developed anywhere in the world, the greatest value is felt locally.

- Consequently, significant focus has been placed on GEO's regional initiatives the past year, with the Executive Committee and Programme Board working with the leadership of AfriGEOSS, AmeriGEOSS, AOGEOSS and EuroGEOSS to discuss the best ways to recognize their uniqueness and their value to the GEO mission.
- Given the magnitude of needs globally, GEO must engage with non-traditional partners, including private and commercial organizations, to make its services and applications routine and global, and realize its full potential.

Mr Volz continued by noting that the Executive Committee has tasked the GEO Secretariat and the Programme Board together to assess the productivity of our current GEO Work Programme and yield valuable insight into the areas of success and areas of need as we move towards compiling the next 3-year Work Programme in 2019. For the Programme Board and Secretariat to be successful, strong engagement of the subject matter experts and the user community involved in these GEO activities is required. He concluded by noting that the 2019 Ministerial will draw participation of leaders from all sectors – government, academia, non-governmental, and private – as they all share stakes in the success of GEO's mission, and requested the active engagement of all GEO Principals to ensure their ministers' participation in the business of GEO. The seeds we plant with our discussions and decisions this week will bear fruits next year – solidifying the recognition that Earth observations are essential for informing decisions and that GEO is the forum for coordinating Earth Observations for decision-making.

Mr Kimiya Yui, Astronaut, Japan Aerospace Exploration Agency (JAXA), opened by commenting that it was wonderful to be invited to be part of this year's Plenary. He informed the audience had been deployed to the International Space Station for five months, which did not seem long at all since life in space was so wonderful. In fact, he did not want to come back to Earth, but was reminded by his wife that he needed to return, and so that was why he was present with the Plenary today. He explained that there were no words to describe how beautiful Earth appeared from space, and he was fortunate to have that view every day. He was impressed to observe how extremely thin the layer of atmosphere surrounding the Earth really was. Generations past used to think there was plenty of air and didn't think twice about spoiling it. Having viewed the atmosphere from space, and how thin it really is, he was convinced of the great need we have to protect it. He was also sobered to see how the glaciers were diminishing over the Earth, that only a small amount remained. When one realized that glaciers provide fresh water for adjacent areas, the accumulated losses directly impact the lives of many people. He also reported seeing hurricanes, dust storms, wildfires, volcanic activity, and thunderstorms, which made him realize the potential of Earth observations to make life better for everyone. When he came back to Earth

and tasted fresh food, breathed fresh air, he was again reminded that Earth is home for all peoples. All humankind is facing lots of problems and challenging issues, which makes it all the more important for everyone to work together to find solutions. From this point of view, he viewed the conference as being very important. He was glad to see many people from many delegations around the world represented at the Plenary, which made him confident we can make a better future for humankind, and all species, on Earth.

Secretariat Director, Mr Gilberto Camara, welcomed the GEO Co-Chairs and thanks Japan for hosting the GEO-XV Plenary. He also acknowledged the importance of Participating Organizations and welcomed the new ones that had joined GEO in the course of the year, which included:

- African Climate Change Research Centre (ACCREC);
- Asian Disaster Preparedness Center (ADPC);
- Afriterra Foundation;
- Centre for Environment and Development for the Arab Region and Europe (CEDARE);
- Environment Pulse Institute (EPI);
- Global Partnership for Sustainable Development Data (GPSDD);
- IHE Delft Institute for Water Education;
- Radiant Earth;
- Resources for the Future (RFF).
- Secretariat of the Pacific Regional Environment Programme (SPREP);
- United Nations Economic and Social Commission for Western Asia (UNESCWA).

This brought the total number of Participating Organizations in GEO to 127 (there were no new Members or Observers in 2018).

He went on to say that one of the aspects of GEO he likes is the diversity of views represented, which required care such that those different views were heard and reflected. He noted that it was a privilege to be in Kyoto, and that visiting magnificent Ryoan-Ji Zen gardens had provided a nice place for quiet meditation, and caused him to think, while Zen masters may have time on their side, our species tends to evolve very slowly. Yet, given the amount of societal challenges currently facing humankind, we do not have time on our side. He remarked that GEO must press on with opening up access to data and lowering the barriers for countries of the Global South to make use of new computing technology in relation to big Earth observation data. Citing a quotation from Nature Magazine:

“A few satellites can cover the entire globe, but there needs to be a system in place to ensure their images are readily available to everyone who needs them. Brazil has set an important precedent by making its Earth observation data

available, and the rest of the world should follow suit.” (Vol 452, Issue 7184, March 2008)

he noted that Brazil had led the way in demonstrating free and open access to data with Landsat and CBERS programmes, and that had influenced the data policies of other governments, including the USA and EC. Also, rigour and quality of Earth observation data are very important for informing decision-making, which can be assured by adherence to “FAIR” principles (Findable, Accessible, Interoperable, and Reusable). As a result of following FAIR principles, Brazil had led the way in forest monitoring and had been very successful in slowing deforestation over the past decade. A part of that success was related to the Soy Moratorium, where farmers who agreed not to deforest the Amazon were awarded farming credit certificates by the Brazilian government. Having the correct information to enforce the Soy Moratorium was critical, a motivating factor that led INPE, the Brazilian space agency, to provide full and open access to Earth observations from satellites.

Very much in line with Mr Yui’s message, he concluded his remarks by observing that the fundamental challenge of our time was to provide food, water, and energy for 9.4 billion people, while avoiding dangerous climate change and protecting our planet’s biodiversity. GEO’s ‘buried treasure’ is Earth observation data, and we must commit to ‘unearth’ it. We do not have time on our side: Earth observation data must be viewed as a common good and released now, for everyone’s benefit and making the world a better place.

1.3 Approval of Agenda

Outcome: The agenda was approved, with no modifications.

1.4 Approval of Draft Report of GEO-XIV

Outcome: The draft report was approved, with no modifications.

1.5 Opening Keynote

Ms Mami Mizutori, Special Representative of the Secretary General, United Nations Office for Disaster Risk Reduction (UNISDR) provided the opening keynote presentation. She prefaced her remarks by noting it was an honour to be invited to address the opening of the GEO-XV Plenary, and thanked the Government of Japan for hosting the GEO WEEK 2018 and ensuring all the support necessary for a successful event, as well as the GEO Secretariat for the overall organization.

She noted that it was her first opportunity to attend a GEO Plenary and was very encouraged by GEO’s efforts to explore efforts and opportunities for the use of Earth observations for the benefit of humankind. The focus on three priority

areas, the Sendai Framework for Disaster Risk Reduction, the Paris Climate Agreement, and the UN Sustainable Development Goals demonstrated great political commitment to reducing disaster risk for sustainable development in a changing climate in a coherent manner. She observed that in an increasingly interconnected world, disaster risks can lead to critical infrastructure failure, undermine sustainable development and jeopardize the well-being of people, especially the poor and most vulnerable. Between 1998 and 2017 climate-related and geophysical disasters killed 1.3 million people and left a further 4.4 billion injured, homeless, displaced or in need of emergency assistance. While the majority of fatalities were due to geophysical events, mostly earthquakes and tsunamis, 91% of all disasters were caused by floods, storms, droughts, heatwaves and other extreme weather events.

She underscored that, in terms of economic losses, while absolute economic losses might be concentrated in high income countries, the human cost of disasters falls overwhelmingly on low and lower middle income countries. Vulnerability to risk and degrees of suffering are determined by levels of economic development, rather than simple exposure to natural hazards per se. And, at a time when climate change is increasing the frequency and severity of extreme weather events, disasters will continue to be major impediments to sustainable development so long as the economic incentives to develop in hazard prone locations such as flood plains, vulnerable coasts and earthquake zones continue to outweigh the perceived disaster risks. The recent International Day for Disaster Reduction, celebrated on 13 October, focused on Target C of the Sendai Framework for Disaster Risk Reduction, reducing disaster economic losses in relation to global GDP by 2030. If development and economic growth are not risk informed, they are not sustainable and can undermine efforts to build resilience. The economic losses which often ensue from the creation of new risk or exacerbation of existing levels of risk can have a significant human and social cost.

Ms Mizutori continued by stating that, in her view, due to the lack of political will and commitment to make serious progress on reducing greenhouse gas emissions, climate change will play an increasingly important role in driving up disaster losses around the world for the foreseeable future. As the UN Secretary-General has recently warned: “If we do not change course by 2020, we risk missing the point where we can avoid runaway climate change, with disastrous consequences for people and all the natural systems that sustain us.” Alongside the global push by the UN and other stakeholders for reductions in greenhouse gas emissions, there is also widespread recognition that we need to accelerate implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030, the global plan to reduce disaster losses by reducing existing levels of risk, avoiding the creation of new risk and managing risks that cannot be eliminated.

Many actions can be taken to reduce disaster risk from the enforcement of land use regulations, implementation of building codes, preservation of protective ecosystems, risk-informed urban development and special attention to the housing needs of the poor and vulnerable in society.

She pointed out that what decision-makers however need in order to assess their risks and take informed decision to build their nations resilience is credible data, which is easily available and understandable. Earth observation and geospatial data has a huge potential to put risks into context and make the case for disaster risk reduction. Over the next couple of days, she observed that GEO will be revising and adjusting its work programme to meet current trends and needs that arise from the practitioners implementing the major agreements of climate change, sustainable development and disaster risk reduction. Additionally, GEO will discuss how earth observation can play a more prominent role in the implementation of the Sendai Framework for DRR and in reducing disaster risk. In this context Ms Mizutori wished to encourage GEO to consider a threefold application for disaster-related earth observation data in its deliberations. More and more countries are moving to put in place national and local strategies for disaster risk reduction by 2020, in line with target (e) of the Sendai Framework, which are:

1. Earth observation data could greatly assist countries in assessing current risk trends with the view of determining the most pressing priorities that disaster risk reduction strategies need to address. The implementation of disaster risk reduction strategies is the precondition to achieving a substantive reduction of disaster losses, hence in achieving the other targets of the Sendai Framework, and therefore urgently need to be developed, based on sound and easily available risk related data.
2. Earth observation data can also assist countries and the international community in monitoring the implementation of the Sendai Framework, the Paris Agreement and the SDGs and hence in taking corrective action where implementation is lagging behind. As such earth observation data can fill gaps which currently exist in official statistics and help to provide a comprehensive picture if the status of implementation.
3. Lastly, earth observation data is already part and parcel of UNISDR's effort in building a collaborative Global Risk Assessment Framework, which will support countries in assessing their systems-risk comprehensively, enabling them to take informed decisions. This effort is greatly appreciated and will support the implementation of the Sendai Framework for DRR.

Ms Mizutori concluded her remarks by noting various opportunities for upcoming collaboration, such as the Global Platform for Disaster Risk Reduction to be held in Geneva in May 2019, and the Regional Platform for DRR for the Asia-Pacific region

in 2020 in Australia. She again thanked the Government and people of Japan, as well as the GEO Secretariat for their hospitality and the excellent organization of this event.

2 Earth Observations in Support of the Sustainable Development Goals

2.1 Panel Discussion

Session 2 featured a Panel discussion presenting Plenary with an overview of GEO's activities in support of the Sustainable Development Goals (SDGs) and providing a view of mandate policy holders as well as end users who can benefit from these efforts.

The panellists included:

- Mr Chu Ishida, Co-Lead Earth Observations in support of the Sustainable Development Goals (EO4SDGs)
- Ms Paloma Merodio, Vice President, National Organization for Environment, Mapping and Statistics (INEGI), Mexico
- Mr Sasha Alexander, Co-Lead GEO Land Degradation Neutrality (GEO LDN)
- Mr Jun Chen, Co-Lead GEO Land Cover
- Ms Izabella Texeira, Co-Chair International Resource Panel (IRP), United Nations Environment Programme

Moderator: Mr Satoru Ohtake, Japanese Agency for Science and Technology.

The keynote presentation was given by Mr Greg Scott, Inter Agency Advisor, United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM). He indicated it was privilege to address the Plenary on the topic of Earth observations and SDGs. A key element was that UNGGIM and GEO have forged a close relationship, to the point that each is observers to the other's Plenary. This relationship has been productive, and has resulted in geospatial language being inserted into the UN 2030 Agenda for Sustainable Development. Another important aspect was that new data and technology have enabled greater support for monitoring progress and achieving SDGs than ever before. Indeed, we are living in a disruptive time, one in which new innovations are driving the world at the moment, and so rapidly that it is not easy to keep up. Data is the new currency and it is becoming difficult to separate data and technology, as they are becoming more closely coupled. This raises new questions, such as how do to work with private industry, and is challenging our view of the science-policy nexus in terms of decision-making.

He continued by noting that Earth observations represent a considerable tool in terms of supporting policy agendas. The SDGs form part of an integrated plan of action, and the 2030 Agenda can be viewed as an overarching policy framework that encompasses both the Paris Agreement, and Sendai Framework. It is important for GEO to speak in the context of these policies, on the need to leverage available Earth observation data and information in combination with geospatial information and statistics. The implementation of SDG targets must be built on a foundation of good data, and the focus needs to be on least developed nations. Additionally, there is a need to think about disaggregation of information, such as gender, age, race, ethnicity, and geographic location, in order to understand not only what is the rate of progress, but where that progress is taking place, and in particular where the hotspots are located. He emphasized the need to change the mind-set of the communities doing monitoring and assessment such that integrated information systems - combining Earth observations, geospatial information and statistics - figure into the equation. This implies an understanding of data requirements, from across a broad range of topics, and how to make different data streams interoperable in order to harness the full potential of those streams. Countries are beginning to recognize that without data, nothing much can be accomplished.

Mr Scott concluded by observing that each year countries must produce an annual progress report on achieving the SDGs, and therefore time is pressing. In order to make greater progress, not only the need for integrated data must be recognized, but data that is robust, trusted and independent. This is where GEO has a great role to play, in assuring the delivery of this type of data. Countries should be able to drive their own agenda in terms of obtaining data and information. It is important to start sharing knowhow for reporting on outcomes. What is needed for developing countries is not just building capability and capacity, but also delivering enabling technology and how to use it. One approach is through data sharing and web services such as the Federated Information System for the SDGs (FIS4SDGs) data hub (UN Data), which is a network of SDG data platforms where countries are building their own reporting mechanisms. Six national hubs are currently online: Ireland, Mexico, Palestine, Senegal, United Arab Emirates, and the Philippines. What is important is that more connections need to be drawn between the environmental and socio-economic aspects of achieving the SDGs. GEO and GGIM need to work together to address the availability and accessibility of Earth observations and geospatial information for production of SDG indicators.

The Moderator then set the context for the session by stating that the SDGs provide a holistic view on global policy and the international frameworks necessary to achieve goal of no one left behind. He reiterated the need for fact-based data, applicable to policy topics and reporting requirements that are both

realized today, and planned for tomorrow, along with the importance of identifying what is currently lacking, yet necessary for the future as nations work towards achieving the SDGs by 2030.

Brief presentations from each of the panellists then followed.

Mr Ishida traced the mandate for use of Earth observations in realizing the 2030 Agenda for Sustainable Development. He remarked that SDGs provide unique opportunity to define roles of EO for sustainable development. Through SDGs, EO can monitor, assess and enable evidence-based decision making on sustainable development. He noted there were two ways that observations could be useful: 1) supporting documentation of targets and goal achievement, and 2) monitoring indicator progress. His recommendation was for GEO to further align its work program activities with SDGs and focus on integrating Earth observations in SDG methodologies; co-designing user-friendly data and tools; and promoting capacity building to assess, monitor, and produce SDG targets and indicators in collaboration with NSOs, line ministries, UN and international organizations.

Ms Merodio explained how Mexico had set up and was using its geospatial data cube. Of particular interest was tracking vegetation evolution in time in the area of Montes Azules and Marqués de Comillas; water observations from space for the Santiago river showing erosion of the river's mouth and tracking shrimp farming; crop identification using machine learning techniques; and progress towards measuring SDG 15.4.2 ('Green mountain cover') in which base data provided by FAO was used and validated. She concluded by noting that monitoring the indicators for the SDGs can promote sustainable development in Mexico, while providing an opportunity to share algorithms and progress with other data cubes across the globe.

Mr Alexander explained that in relation to monitoring land degradation, having the practical tools to understand big data was the key to getting correct information to decision-makers. He pointed out that SDG 15.3.1 was one of the few actually making direct use of Earth observations for reporting. Part of UNCCD's strategy for uptake of observations was to invite National Statistical Offices (NSOs) and geospatial experts to UNCCD for capacity building and good practice guidance training workshops. The GEO LDN Initiative was established a year ago to enable reporting at national and sub-national levels, and includes three working groups on capacity building, data quality standards, and data analytics, to work towards sustainable land degradation neutrality. All are welcome to join in the working groups.

Mr Chen informed Plenary of a case study that China had been conducting at the level of Deqing County, involving comprehensive measurements towards SDGs using statistical and geospatial (Earth observation) data. 104 indicators had been chosen (out of 232 total) for examination, based on suitability for the Deqing

region, facility for national and international comparison, and data availability. In some instances, an individual SDG, such as SDG 6, was selected for in-depth analysis. Preliminary results were encouraging, showing that overall progress towards SDGs of an entire region can be measured by combining geospatial and statistical information, and that Earth observations play a number of important roles. Further work needs to be done, including documentation of developed methodologies, key variables-based monitoring, analysis of goal interactions, as well as applications to larger areas.

Ms Teixeira spoke on Brazil's experience in using Earth observation data, information and indicators to make sense of, and bring together, national sustainable development strategies for combatting climate change. Brazil worked to develop a narrative that would bring stakeholders together and comply with reporting on achieving the SDGs. This strategy aimed to move beyond a simple discourse of deforestation rates and monitoring biomes, and included assessment of current land use in the context of development of a new political role for agriculture. Key components included available data, driving forces, pressures, trends, solutions and new economic and political constituencies, aiming for decarbonisation/carbon neutralization routes for Brazilian agriculture. A challenge for agriculture was that it represents a mobile frontier a nexus trying to balance of no deforestation, water security, and protection of biodiversity/ecosystems services. A similar narrative approach was also being applied for Brazil's commitments to the Paris Agreement.

Next, questions from the floor were responded to by members of the panel, which included:

- Q: Is a big central data cube all that is needed to manage and analyse big data, or can web services be used?
 - Ms Merodio responded that a number of countries have expressed interest in data cubes in order to use big Earth observation data. This technology makes processing easier, alleviating difficulties with interoperability. She also felt there was a need to work on how to integrate data in a more efficient manner, and some countries were starting to talk about Latin America data cube. Sufficient resources remain one of the biggest challenges.
- Q: In some countries, a lack of SDG-compatible indicators data means relying on proxy data, which is an issue for comparability - how should this be addressed?
 - Ms Teixeira replied that, although experience has shown that data is indeed not necessarily available for all indicators, and reporting on the SDGs is a work in progress. Building a narrative can help, one that identifies processes and strategies for tackling issues

- such as food security, soil degradation and so forth. The narrative should highlight the common understanding of the challenges in context of climate change, combined with the need to leverage technology. Narratives are a bridge to bring science and society together, in the quest to leave no one behind.
- Mr Chen offered that using proxies such as number of people requiring health care facilities may be helpful.
 - Ms Merodio added that disaggregation of data and how to use it in SDG reporting was an area that INEGI was working on. It's not just about a lack of data, but how to present it once you have it.
 - Mr Ohtake observed that, although SDGs are global in scope and comparative data analyses were important, we must bear in mind that intercomparisons work at the general level, and in some cases are not applicable to specific contexts of countries.
 - Q: By placing so much emphasis assessing SDG indicators and drafting reports, was there not a risk of missing the bigger picture of using Earth observations for implementing the SDGs (for example, in terms of best practice, capacity-building, or informing decision-making)?
 - Mr Chen replied that producing evidence-based results naturally implies decisions informed by geospatial information in conjunction with Earth observations, at all applicable levels.
 - Mr Alexander added that Earth observations should be seen as a means to an end, so geospatial information and observational data must be presented in a way that decision-makers can understand whatever the ultimate application.
 - Ms Teixeira commented that traditional approaches to deforestation needed to shift to include interaction with the agricultural sector at the local level, and communicate in a way they can understand. If one wants to influence the decision-making process, short-term solutions must be considered in addition to long-term and observational data and information must be used to convince people to change as quickly as possible.
 - Q: Which strategy do you have to harmonize and integrate the many emerging platforms regarding Earth observations for SDGs? Is there a duplication of efforts?
 - Mr Ishida responded by saying this was not an easy question. Indeed, there are many data aggregation platforms available and it is difficult – if not impossible - to harmonize all of them. However, some platforms are designed for specific usages, so the GEO community should make it a point to share data and communicate best practices in order for a consensus to evolve.

- Mr Alexander agreed that communication is important for avoiding duplication.
- Mr Ohtake added that finding shared goals will allow a natural collaboration to happen, thus preventing duplication and saving resources.
- Q: What one item is the most important to each of you as panellists, to express to Plenary?
 - Mr Ishida: The need for establishing and clearly communicating major priorities for government policy and processes.
 - Ms Merodio: Capacity development and knowledge sharing among the GEO community is crucial.
 - Mr Alexander: Having a passionate commitment to a shared vision.
 - Mr Chen: The need to promote knowledge and good practices among the GEO community.
 - Ms Teixeira: Finding and sharing solutions that works in the real world.

2.2 Panel session outcomes and recommendations

1. Engagement in EO4SDG is a good entry point to the GEO Work Programme and activities on the use of Earth observations for monitoring, reporting and implementing the SDGs.
2. More work to be done to integrate SDGs across the GEO Work Programme to help provide evidence-based decision making and addressing the data needs: reporting on outcomes.
3. Digital transformation is important, many countries now working on data cubes. As highlighted by Mexico, there are opportunities for GEO members to engage around the open data cube.
4. UNCCD has a UN mandate for land degradation and is working with GEO to use EO for SDG 15 reporting; 145 countries are already considering use of EO for SDG work.
5. GEO encourages closer integration of EO with statistical and other types of information for operational support to the SDGs; this aligns with the work of UN-GGIM. This also includes working more closely with national statistical offices, line ministries, UN and international orgs.

3 Earth Observations in Support of the Paris Agreement

3.1 Panel Discussion

Session 3 featured a panel discussion with an overview of GEO's activities supporting the Paris Agreement. Currently, several GEO activities focus on mitigation while there is great potential for Earth observations to also support climate adaptation and activities that limit loss and damage.

The panellists included:

- Margareta Johansson, INTERACT (Infrastructure project under SCANNET);
- Robert Duncan McIntosh, Oceanography Officer, Secretariat of the Pacific Regional Environment Programme (SPREP);
- Keith Garrett, Senior Geographer, Geospatial Operations, World Bank Group;
- Nobuko Saigusa, Director, Center of Global Environmental Research.

Moderator: Werner Kutsch, ICOS Director, Head of GEO-C Secretariat.

The keynote presentation was given by Mr Florin Vladu, Adaptation Programme, United Nations Framework Convention on Climate Change (UNFCCC). He started by explaining the structure of the Paris Agreement on Climate Change, and how Earth observations can play a key role in addressing climate change and by supporting the work of the UNFCCC – Global Climate Observing System (GCOS) cycles (status, implementation, progress) and mechanisms (funding, regional needs), through various means such as actions and reporting, links with space agencies, and activities of the GEO Work Programme. Earth observations are also needed to support research for understanding and predicting changes, to facilitate dialogue and guidance on priority research (e.g., for implementing the Paris Agreement, for filling in the gap on 1.5°C) as well as assessment of the current state of knowledge in climate change and its potential environmental and socio-economic impacts.

He emphasized that the world was at a critical moment in the climate change process. The devastating effects of climate change are causing destruction and suffering in all regions of the world. At the beginning of this month, the Special Report of IPCC on Global warming of 1.5-degrees Celsius indicated that the world has already warmed by 1°C and that any additional warming will exacerbate the situation. The Fifth Assessment Report of IPCC told us that we are not on track for limiting global warming below 2°C. In response, governments adopted in Paris an Agreement which is designed to correct this over time. They acknowledged that

limiting global warming is a moral imperative and lowered the accepted level of global warming to well below 2°C and agreed to pursue efforts to limit warming to 1.5°C. Citing Article 7.7(c) of the Agreement which calls on Parties to “strengthen scientific knowledge on climate, including research, systematic observation of the climate system and early warning systems, in a manner that informs climate services and supports decision-making”, he noted that GEO several of GEO’s Flagship, Initiative and Community Activities were responding to the Earth observation needs for supporting the Paris Agreement.

Mr Vladu concluded by observing that limiting global warming to 1.5°C in line with the Paris Agreement would require rapid, far-reaching and unprecedented changes in all systems, including:

- A range of technologies and behavioural changes;
- Scale up in annual investment in low carbon energy and energy efficiency by factor of five by 2050;
- Renewable energy sources supplying 70-85% of electricity by 2050;
- Coal usage declines steeply to approximately zero for electricity production by 2050;
- Cutting emissions associated with transportation and buildings; and
- Changes in land use and urban planning.

Radical measures would need to be taken, featuring pathways that require Carbon Dioxide Removal (CDR), to limit global warming to 1.5 °C. At the same time, these pathways would carry implications for land, food and water security, ecosystems and biodiversity. In trying to find the balance with competing objectives, Earth observations could help with ensuring synergies and on decoupling positive action on limiting global warming at 1.5°C from potential negative outcomes with achieving certain SDGs. The benefits far outweigh the costs of inaction and better Earth Observations will help developing a coherent policy and strengthening adaptation and mitigation action. For these reasons, his recommendation was that GEO should strengthen its involvement in the UNFCCC process.

The Moderator prefaced the panel discussion by thanking Mr Vladu’s positive assessment of the role of Earth observations in supporting the Paris Agreement, and noting that the GEO Vision is very much aligned with the Agreement as it calls for decisions and actions for the benefit of humankind to be informed by coordinated, comprehensive and sustained Earth observations. He noted that the mapping exercise performed by the GEO Programme Board showed that the Work Programme has great potential for supporting the Paris Agreement.

Brief presentations from each of the panellists then followed.

Ms Saigusa spoke on the importance of observing the land sink of carbon in order to fully understand the terrestrial carbon cycle. She noted that there is a great amount of uncertainty in global and regional carbon budget estimates, due to the high spatial and temporal variability of the land sink. Examples of uncertainties in carbon budgets included both emissions from anthropogenic land-use changes as well as El Niño-induced (peat) forest fires across Southeast Asia. Therefore, spatial distributions of natural and anthropogenic sources/sinks of carbon and other greenhouse gases are required to support the Global Stocktaking Process. Earth observations, combined with terrestrial ecosystem modelling, are essential for improving carbon budget estimates as well as complementing national inventories.

Mr McIntosh outlined ways to Support Pacific Islands in the Paris Agreement, including training negotiators, assisting policy development, implementing mitigation & adaptation projects, and facilitating climate finance through accreditation processes. He emphasized that Earth observations enhance and/or underpin each of these aspects of support for Pacific Island States in the UNFCCC process. Building capacity of Pacific Islanders to monitor and report ocean acidification data in reporting on SDG Indicator 14.3.1 was one example. He called on GEO to help meet challenges faced by Pacific Island States through providing smart solutions around poor internet connectivity; promoting in-country capacity building, data awareness and interpretation; and facilitating access to high-resolution Earth observation data along with nation-scale derived Earth observation products.

Ms Johansson informed Plenary about the work of INTERACT, which featured a network of 83 research stations across the Arctic region. In terms of the Paris Agreement, she noted that Earth observation in the Arctic were critical for monitoring and understanding feedback mechanisms, given that the region is warming twice as fast as the rest of the globe. Observations supplied by the network were also applicable to achievement of the SDGs in the areas of environmental data (SDG 13), rapid response (SDGs 3 and 5), education (SDG 4) and minimising footprint (SDG 9).

Mr Garrett spoke about the need for transparency around the decision-making process, and this is where Earth observations play an essential role. The World Bank has adopted a strategy for decision-making which relies on free, open, machine-readable data. Earth observations also need to be a part of policies that help local stakeholders solve local problems.

Next, questions from the floor were responded to by members of the panel, which included:

- Q: What can GEO do for the Arctic?

- Ms Johansson responded that there are many opportunities to leverage the invaluable information from indigenous peoples. INTERACT is working with both local communities and research stations to develop best practices on how to adapt to future climate change.
- Ms Nabuko agreed that indigenous knowledge can be helpful for defining local regions and experiences particular to those areas.
- Mr McIntosh added that local knowledge was also important in the island context. An example was predicting drought in the Marshall Islands in correlation with the El Niño/Southern Oscillation (ENSO) phenomenon. Local knowledge was also useful for determining how indigenous peoples defined their islands geographically. Knowing how they viewed their world was important for defining services in a way relevant and recognizable to them.
- Q: What type of Earth observation data leading to relevant information would help address apparent deadlocks on implementation of adaptation/mitigation actions(s)?
 - Mr McIntosh responded that decision-makers prefer not to have to deal with raw data. Rather, they need derived products that help them, such as land carbon inventories or loss and damage accounting. Having derived products from a single trusted source such as GEO would be a tremendous help to decision-makers.
 - Mr Garrett added that Earth observations are key inputs for modelling the potential for, and development of, renewable energy systems, such as solar energy potential.
- Q: Plenary has heard over and over about the criticality of open data, but the fact remains that there are a lot of data that are fully and openly accessible. How do we move forward on this issue?
 - Mr Garrett indicated that the World Bank might consider an open data policy as a requirement for any projects that it funds.
 - Mr McIntosh commented that the bigger issue for small island states was having the capacity to use those free and openly accessible datasets and products that already exist, understand how they work and how to apply them in the small island context. They simply do not have the funds to purchase expensive infrastructure, let alone big datasets.
- The Moderator then asked each panellist for final statements, addressing the question: “What are you expecting from GEO, what could it do better?”
 - Ms Johansson responded that it had been extremely useful to be a part of GEO Initiative such as GEO CRI, which afforded the

- opportunity to network with others and connect with those doing work in cold regions, and asked for continued support.
- Mr McIntosh noted that very few, if any Small Island Developing States (SIDS) were Members of GEO, which obviously needed improvement. However, in the interim, SPREP was pleased to participate in Plenary and represent the interests of SIDS.
 - Mr Garrett called for patience as work continues to understand both the policy and human sides of the issues related to the Paris agreement, as these will take time to develop. Additionally, GEO needs to consider how small businesses should benefit from freely available Earth observations.
 - Ms Nabuko observed that much in-situ data collection currently happened on a volunteer basis. However, in-situ data is critically important for validation of estimates of parameters for reporting under the Paris Agreement, such as biomass and soil carbon, and she asked GEO to increase support for in-situ data collection and curation.

3.2 Panel session outcomes and recommendations.

1. GEO should strengthen involvement in the UNFCCC process as the global response strengthens.
2. A coordination mechanism is required across the GEO Work Programme: Mitigation, Adaptation, Loss and Damage, National Reporting and Global Stock take, Capacity Development and Technology Transfer (as well as infrastructure support).
3. Mapping the potential of Earth observation to provide informed decisions is the first step. Now pilots should be developed to demonstrate information flow across the value chain.
4. Terrestrial ecosystems and oceans provide important sinks but are also vulnerable to climate change. Adaptation needs to consider these 'services' by nature and Earth observation is a key instrument to guide measures to preserve them.
5. GEO members: your national contribution to GEO is to strengthen the existing in-situ observational capacities, whether national agencies or in research infrastructures, and encourage them to provide FAIR and open data. In return, you will receive knowledge through those observations to guide your national action plan.

4 Broadening Engagement

4.1 Presentation of Regional Initiatives

Mr Xingfa GU, Deputy Director, Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, provided highlights of Asia-Oceania GEOSS (AOGEOSS). Key Activities for 2018 included the creation of a coordination board and expansion of participation across the region; an International Symposium focusing on an international Science and technology program, development of observing capacity, data processing and information products, regional applications, and data sharing. Nearly 90 young scholars from 14 countries in the AO region were financially supported through international training courses. As part of broadening participation, an AOGEOSS pilot study on needs for the Mekong River basin had been initiated, involving the participation of Cambodia, Laos and Vietnam. The project will utilize existing infrastructure to collect and combine remotely-sensed and in-situ observations with state-of-the art tools and knowledge to create a decision-supporting platform for achieving the SDGs in areas such as water-related disaster risk assessment, improvement of rice yield outlooks, and estimation of methane emissions from rice paddy fields. Creation of a science-policy interface is a main objective for 2019.

Mr Gilles Ollier, Head of Sector Earth Observation, Directorate-General for Research & Innovation, European Commission, spoke on recent activities of EuroGEOSS and how it was delivering an integrated European contribution to GEOSS. A major component of that contribution included serving as an incubator in cooperation with Copernicus and European countries/organisations to produce and test Earth observation services and applications that benefitted from integrating global datasets made available through GEOSS. Other objectives the past year included building on Copernicus Data & Information Access Services (DIAS) and outputs of the Horizon 2020 research programme, as well as supporting the implementation of the Agenda 2030 for Sustainable Development across Europe. EuroGEOSS promoted collaboration across Europe through open innovation partnerships. These can be facilitated by either participation in fixed-term funding projects (such as Horizon 2020) or directly through expressions of interest to collaborate on applications across nine action group domains (agriculture, land use/land coverage, urban and disaster resilience, biodiversity and ecosystems, marine, climate, atmosphere and energy). Projects developed through these partnerships brought together data from the Sentinel satellites and in-situ observations, the internet of things and crowdsourcing with new data analytics techniques and deep learning algorithms, demonstrating how EuroGEOSS leveraged the GEO spirit and value chain to deliver societal benefits.

Ms Angélica Gutiérrez-Magness, International Hydrology Lead, Office of Water Prediction, National Oceanic and Atmospheric Administration (NOAA), presented perspective on implementing GEOSS across the Americas through AmeriGEOSS. She noted that AmeriGEOSS reflects local, national, and regional interests of the GEO Members in the region for short and long-term planning, development, and implementation aligned with GEO activities. Capacity building had been a key focus over the past year, with GEONETCast capabilities expanded to 80+ stations and hands-on Earth observation training provided during the AmeriGEOSS week. The US has embarked on 17 new projects in support of AmeriGEOSS, including capacity building for using Synthetic Aperture Radar (SAR), connecting Earth observations to indigenous peoples, and monitoring vector-borne diseases across the Americas. Another key output was further development of the cloud-based AmeriGEOSS platform that provides data, information and knowledge, and collaborative analytics tools and for the development of products and services, such as a water-food security nexus application.

Mr Humbulani Mudau, Department of Science and Technology, South Africa, illustrated recent successes of AfriGEOSS, which included improvements in data infrastructure and resources, and the production of land use/land cover maps for development of a System for Land-based Emissions Estimations for Kenya (SLEEK), coordinated through RCMRD. Contributions from the Global Human Settlement Layer Initiative had contributed to a greater understanding of population concentrations across the continent, down to the village level, and changes in distribution from 1975-2015. Agricultural Information had also been consolidated and improved thanks to the contributions of GEOGLAM to the AfriGAM initiative, working to provide timely crop monitoring information (NDVI, soil moisture, precipitation, temperature and evapotranspiration) across Africa for early warning decision-making. He concluded by calling for development of user-tailored data delivery platforms (web-based, cloud, smartphone, affordable satellite communication and offline services) that take into account the infrastructure challenges of Africa, as well as enhanced coordination of Earth observation activities in order to maximize successful and sustainable impact, with AfriGEOSS linking the regional initiatives with regional policy agendas.

4.2 Role of Regional GEOs

The Chair introduced the proposal from the Programme Board defining the Role of Regional GEOs, noting that the document was the culmination of a reflection on what kind of structure the regional GEOs actually were. Plenary was being asked to accept the recommendations stemming from the work of the Programme Board.

Mr Imraan Saloojee, Manager Stakeholder and Business Development, South African National Space Agency (SANSA), summarized the Programme Board recommendations, noting that the document was asking Plenary to:

- note the distinguishing characteristics and unique value of the Regional GEO constructs; and
- approve that Regional GEOs be recognized as an extension of activities of the GEO Caucuses.

He emphasized this decision was important to: empower regional activities to best respond to regional and local needs; foster engagement of relevant regional stakeholders; leverage senior leadership of the GEO Caucuses in order to maximize opportunities; and provide due recognition of the extent of Regional GEO activities.

The floor was then opened for comments.

Italy appreciated the rationale of the document, noting that the recognition of Regional GEO helped create order by distinguishing them from more thematic Initiatives of the Work Programme. Italy would prefer to leave flexibility for the Regional GEOs to undertake coordination arrangements, such as creation of infrastructure, and not be categorized as simply a group of activities.

Japan appreciated the proposal, noting it had hosted several GEOSS Asia-Pacific Symposia since GEO's inception, thus promoting sharing data and contributing to problem solving throughout the region.

Russia asked for clarification among the different options being presented in the document.

China indicated that it was pleased to see the key role Regional GEOs have been playing, and fully supported the proposal along with the changes to the Rules of Procedure. The new Regional GEO category will recognize that Regional GEOs are overseen by the Caucuses, and China stands ready to help fulfil this function.

Bangladesh commented that, as a small country with a diverse environment including numerous rivers, it could greatly benefit from any interventions on its behalf by the Regional GEO approach, particular in providing high-resolution data.

The US responded to Italy's concern, noting that the proposed changes to the Rules of Procedure (Article 8) did not limit the ability for Regional GEOs to develop products and services, according to what they decide is best for them.

Italy added that article 8.2 included a long list of functions, and questioned how this would be reflected in the Work Programme. Italy offered to provide text in this regard for the development of the 2020-2022 Work Programme.

The chair, noting that there were no objections, declared that Plenary had approved the definition of the Regional GEO.

4.3 Proposal to create a GEO Associate Category

The Chair prefaced the discussion on the creation of a GEO Associate Category by emphasizing that the proposal was in no way changing any privileges of the GEO Member governments. He then went on to highlight some of the issues surrounding the category of GEO Participating Organization (PO):

- There was ambiguity in current PO eligibility criteria, which this proposal addressed;
- There was a need for a mechanism permitting a greater range of organizations to be formally associated with GEO, including the commercial sector; and
- The Mexico City Declaration was a call for broader engagement, end users in particular, and this proposal responded that request.

The chair summarized that the new category of GEO Associate would:

- enable eligible entities to contribute to and participate in GWP and to the GEO Trust Fund;
- not form part of any of the GEO governance structures (although an Associate would have the right to make an intervention at Plenary on items not presented for Plenary decision); and
- be limited to i) non-governmental, not-for-profit entities with a national or sub-national mandate or scope, and ii) commercial sector firms and/or their associations, none of which are currently eligible to become POs.

The Chair noted that Associates could be removed if inactive, and that the GEO Observer category would henceforth be limited to governments only. Before opening the floor for comment, the Chair informed Plenary that the Executive Committee recommended approval in principle of the GEO Associate category, with any details where Plenary could not find complete consensus be left to the Executive Committee to resolve by the time of its 47th meeting in March, 2019.

Canada expressed its approval of the proposal, and encouraged resolution of any outstanding issues is resolved at the latest by the 47th Executive Committee meeting in March 2019.

France supported Section 1, and found that it was fully in line with spirit of thinking around POs. France also fully supported engagement with the private sector, and noted that Annex C set forth important basic principles, that GEO is first and foremost driven by governments promoting data sharing as they adhered to the highest standard and impartiality. However, France was convinced that

GEO governance would be changed by the Associate category, given that an Associate would have the right to speak at Plenary on any topic except decision points. France also was concerned with how transparency and accountability would be managed, given that Plenaries may become much larger affairs with the inclusion of Associates. France further saw a potential issue in that the proposed changes to the Rules of Procedure related to Associates involvement in the Work Programme and contributions to the GEO Trust Fund, but fail to mention adherence with GEO ethics. Finally, issues related to Intellectual Property Rights had not been addressed, and therefore France called for major revisions to the proposal to resolve these points.

UN-GGIM commented that they had successfully set-up the Private Sector Network (PSN) with the support of UN Members States and this has facilitated commercial sector engagement.

China fully recognized value of engagement with the commercial sector and supported in principle the new category of GEO Associate. However China would like to have a more detailed discussion regarding criteria for eligibility. China stressed that GEO is first and foremost an intergovernmental organization, so Member governments should review Associate applications prior to approval.

Australia supported the GEO Associate category, finding it to be an effective way to incorporate the commercial sector and provided a mechanism for GEO to collaborate at the national and sub-national levels. Australia was comfortable with proposal language and confident that the proper safeguards were in place.

Germany wished to encourage inclusiveness, including the commercial sector, and supported the creation of the GEO Associate category. However, Germany saw the need for clear agreement on processes to properly manage Associates, in order to preserve GEO as intergovernmental organization. In this regard, Germany believed more work was needed to fine-tune the language in the Rules of Procedure and thus did not approve of proposed changes.

South Africa fully supported the proposal, noting that, as a nation, it was committed to service delivery and thus recognized roles that non-governmental organizations (NGOs) could play. South Africa was confident that the Executive Committee could sort out any outstanding issues by the time of its 47th meeting.

Spain echoed most of the concerns expressed by France and Germany regarding the role and future of GEO as an intergovernmental organization, and noted that, in addition to other considerations, it was important that contributions from the commercial sector remain separate from the GEO Trust Fund. On the other hand, Spain stressed the need for the approval process of new Associates involving national or sub-national organisations to depend first and foremost on a decision by a GEO Principal.

ISESTEL, as a newcomer to GEO, observed that if GEO wants to work effectively and sustainably, it would be good to include as many institutions as possible. ISESTEL supported the proposal for the GEO Associate category, especially to the extent that it would include the private sector, a gap in the GEO landscape thus far. As an academic institution, ISESTEL also asked Plenary to think about fact that academic institutions were needed to help build sustainability as they frequently worked directly with end-users.

The United Kingdom supported the proposal, observing that it was important to expand engagement with end-users and the commercial sector. At the same time it recognized that a few details still needed refinement to ensure transparency and adherence to GEO ethics and principles, and expressed confidence that the Executive Committee was capable of working through these issues.

Switzerland commented that further work was necessary to define exact modalities in connection with the GEO Associates category. Switzerland supported the proposal by France to rework the language in a consultation process with all GEO Member governments, not just the Executive Committee, resulting in a concrete proposal that could be taken up by the next GEO Plenary.

Japan recognized the importance of engaging with the commercial sector and was fully supportive of the proposal for a GEO Associates category, with the understanding that the Executive Committee would address the issue of transparency.

Norway supported the creation of the GEO Associate category, but also subscribed to the comments by France, Germany and Switzerland.

Finland suggested that Plenary accept the Executive Committee recommendation and allow them to do their work. It was important to not let the process be drawn out until next year's Plenary. GEO thinks of itself as nimble and agile, therefore it should be ready to react quickly and not reticent to try something new. Increasing the numbers of entities within the GEO community is not necessarily a bad thing, it could even attract the attention of Ministers, so Finland recommended acceptance in principle, and leaving the Executive Committee to iron out the details mentioned.

The United States endorsed the proposal, noting the approach was consistent with intent and spirit of the GEO Strategic Plan. In its view, over past few years there had been a strong momentum building within GEO for broadening engagement with the commercial sector, which up this point did not have the capability of applying for PO status. Acceptance of this proposal would show important progress towards accomplishing goals of previous Ministerial Declarations. The US recommended allowing the Executive Committee to work on any outstanding details.

Italy supported the proposal to create the GEO Associate category, finding it would make GEO stronger, more visible, and have a greater impact with involvement of the commercial sector.

Australia reminded Plenary that progress is fundamental to health of GEO, and it needed to connect with users in a way that creates impact. Ministers have asked GEO to take these steps and they will wonder why GEO has not taken action if a decision is postponed until next year's Plenary and Ministerial. Australia believed any potential risks could be managed through intervention of the Executive Committee, in the manner proposed.

Sweden supported the proposal, expressing trust in the Executive Committee to find any requisite solutions.

The Chair summarized by noting that none of the interventions objected to the proposal in principle, but that concerns about the language remained. He suggested that a small subgroup convene to try to address comments that had been made, and propose a way forward at the opening of Plenary the following morning. Representatives from Australia, China, France, Germany, Japan, México, South Africa, USA, AGHRYMET, CEOS, ISESTEL and the OGC agreed to form the subgroup.

Meeting adjourned at 6:00 pm.

Thursday, 1 November 2018

Meeting convened at 09:00 am.

4.3 Proposal to create a GEO Associate Category –continued.

The sub-group reported that it had come to a consensus, and proposed the following:

1. Recommendation to Plenary:
 - Approve, in principle, creation of GEO Associate category, and delegate the authority to the Executive Committee to resolve remaining issues of process.
 - The Executive Committee to establish a sub-group to consider and address the open issues and complete the minimum changes to the Rules of Procedure to define the GEO Associate category
2. Sub-group should:
 - Be small and focused, with interested and vested participants from the GEO Members, including but not limited to, Executive Committee

- members. Participating Organizations were also invited to join the group.
- Distinguish between Rules of Procedure issues and routine practices.
 - Address and clarify:
 - selection criteria;
 - voice and practices for Associates within GEO;
 - principles of involvement, including legal status; and
 - handling of contributions.
 - Complete activities at least 1 month prior to the 47th Executive Committee meeting March 2019.
3. Action to Plenary:
- Volunteers for sub-group to contact Yana Gevorgyan (USA) prior to close of Plenary.

Sub-group volunteers included:

Australia, China, EC, France, Germany, Italy, Japan, South Africa, Spain, Switzerland, USA, EARSC, OGC.

5 2017-2019 GEO Work Programme

5.1 GEO Programme Board Report

Mr Osamu Ochiai, Associate Senior Engineer, Japan Aerospace Exploration Agency (JAXA) and Programme Board co-chair, provided the report. He started by reminding Plenary that the function of the GEO Programme Board was “to support” the ongoing development and implementation of the GEO Strategic Plan through the “GEO Work Programme”. A large part of the Board’s work in 2018 had focused on support for the GEO Engagement Priorities through subgroups for SDGs, Paris Agreement and Sendai Framework:

- SDGs: the Board reviewed progress within relevant Work Programme activities, noting the need for GEO to engage more with socio-economic data providers and organizations.
- Paris Agreement: the Board organized a Climate Symposium, held in conjunction with the GEO Symposium. The Symposium provided a set of recommendations for the application of Earth observations to the Agreement. A second symposium is planned to further the role of Earth observations for the Agreement, including engagements with country and UN stakeholders.
- Sendai Framework: a sub-group was created to identify how GEO could contribute and work with UN agencies, such as UNISDR, and other policy organizations. This work will continue throughout 2019.

Otherwise, the Board had been active in considering the role of Regional GEOs, and wished to stress that they should remain visible in the Work Programme even though they will no longer be under Board oversight. The Board also considered that data and information infrastructures developed by Regional GEOs must abide by GEO Principles such as GEOSS Architecture Principles, Data Sharing Principles and Data Management Principles, thus ensuring interoperability among different Regional GEO infrastructures.

Looking ahead to 2019, the Board was in the initial planning phases for the 2020-2022 GEO Work Programme and had sketched out a timeline for delivery. Additionally, the Board anticipated close coordination with 2019 Ministerial preparations as well as with the Secretariat in implementing the strategy for a results-oriented GEOSS proposed by the GEO Secretariat Director. Finally, the Board was considering next steps to respond to the gap in terms of coordination of in-situ observations, and would explore ways for GEO to expand its role in this area.

China suggested that outcomes from the 2019 Ministerial should be taken into account in the planning of the 2020-2022 GEO Work Programme.

Australia hoped that reorganization of the Regional GEOs would not hamper their current progress in any way.

5.2 GEO Highlights:

Mr Ian Jarvis, GEOGLAM Secretariat Coordinator, provided an overview of GEOGLAM's recent activities, noting that in 2018 the G-20 Agricultural Ministers had confirmed their continued support of the Flagship in recognition of its mechanisms to promote transparent markets and food security. GEOGLAM continues to provide a monthly crop monitor for the Agricultural Market Information System (AMIS), covering 80% of the global production of four major agriculture commodities (maize, rice, wheat and soybeans). New this year was establishment of a crop monitor with the Kenyan Ministry of Agriculture, in cooperation with GEOGLAM, NASA Harvest, NASA SERVIR and RCMRD. Additionally, thanks to Earth observation based crop monitoring analyses, the government of Argentina was able to declare an "agricultural emergency" with great spatial precision during the 2017-2018 Argentina droughts, thus triggering financial safety net programs to support Argentine farmers. A year earlier, the crop monitor in Uganda provided 3 months early warning of a likely crop failure due to drought, allowing the government time to proactively mitigate loss and damage. The recently launched Mekong River basin rice monitoring initiative will make use of data cube technology to provide early warnings across the transboundary basin.

Ms Angélica Gutierrez-Magness, NOAA, reminded Plenary that the GEO Global Water Sustainability (GEOGLOWS) Initiative was working to provide relevant, actionable information about water that promotes the use of Earth observations while strengthening observational networks in local operational frameworks. Recent milestones of the Initiative included development of a priority list for Essential Water Variables (EWVs) and identification of Earth observations in support of achieving SDG 6 (clean water and sanitation). She also announced that the Asian Water Cycle Initiative (AWCI) had agreed to join the Initiative. Mr Jim Nelson, Professor, Civil & Environmental Engineering, Brigham Young University, informed Plenary that the GEOGLOWS Partnership had brought together experts from around the world to create a global streamflow forecast product that is freely available, providing actionable information as a service to places where little or none exist, and filling gaps that can complement and strengthen national, regional, and local efforts. The GEOGLOWS global streamflow pilot has demonstrated that it is possible to simulate historical streamflow and provide an operational 15-day forecast on every river in the world that is freely accessible on the web and reusable in custom applications.

Mr Nicola Pirrone informed Plenary that the Global Observation for Mercure (GOS4M) Flagship aimed to support the UN Environment, end-users and policy makers in the implementation of the Minamata Convention by providing a knowledge platform to assess the fate of mercury in the global environment and its impact on human health. Recent achievements included development of the Minamata Knowledge Platform, based on a knowledge production cycle that moves from knowledge (community based) and data collection (remotely-sensed and in-situ) on mercury, to data assimilation, then to projections involving predictive, social and economic modelling, and finally resulting in knowledge to be shared via the GOS4M web portal. Working closely with local communities in the knowledge production cycle has ensured co-design with relevant stakeholders and end users.

Mr Sasha Alexander, UNCCD, recalled for Plenary that UNCCD COP13 (2017) invited GEO to support the UN Convention to Combat Desertification by providing space-based information and in-situ measurements to fulfill the reporting requirements for SDG indicator 15.3.1. Following formal acceptance of the GEO LDN Initiative by the Programme Board earlier this year, an interim steering committee had met in June to decide on terms of reference and outline activities for three working groups on capacity building, data quality standards, and data analytics. A PO involved in the Initiative, Conservation International, had helped develop analytical software (Trends.Earth) that operates as a free plugin for QGIS 2.18, to support integration of default data, other global data products and national data. Mr Alexander noted that objectives for LDN were much broader than simply monitoring and reporting, but rather looked to connect data

providers to data users in order to optimize the use of EO datasets for LDN assessment, planning, implementation, monitoring and reporting. All GEO Members and POs were invited to become part of the LDN Steering Committee and/or working groups, which was to meet formally on 2 November.

5.3 Update of the 2017-2019 GEO Work Programme / Discussion, Pledges and Approval

Mr Craig Larlee, Work Programme Coordinator, GEO Secretariat, outlined the main changes contained in the update to the 2017-2019 GEO Work Programme, which included:

- New GEO Initiatives:
 - Land Degradation Neutrality
 - GEO CRADLE (moved from Community Activities)
- New Community Activities:
 - Arctic GEOSS
 - Global Marine Ecosystem Monitoring
 - Global Wheat Pest and Disease Habitat Monitoring and Risk Forecasting
- Community Activities discontinued:
 - Earth2Observe (project completed)
 - African Geochemical Baselines

He explained that the Programme Board had reviewed the updates to the 2017-2019 GEO Work Programme and recommended acceptance by GEO Plenary. He also reminded Plenary that acceptance implied that the GEO Flagships, Initiatives, Foundational Tasks and Community Activities were expected to be implemented with the corresponding indicative resources. Additional pledges of contributions to the GEO Work Programme were welcomed and would be included in the final version of the Work Programme update following Plenary.

Australia announced that Digital Earth Africa intended to enter the Work Programme as a Community Activity in the near future.

Switzerland commented that the concept of Essential Variables was evident across several SBAs, and suggested that the 2020-2022 GEO Work Programme should contain a coordinating initiative to help reach a common agreement on what actually constitutes essential variables. .

Germany observed that the GEO Work Programme represents the core of GEO's work, and suggested that future Plenaries should feature more presentations like the ones just given (GEOGLAM, etc.). More information should be shared about how Earth observations were helping society, with fewer discussions about GEO structure. Germany was pleased to announce it had doubled its contribution to

the Trust Fund and intended to provide similar amounts over the coming years, subject to budget decisions. Germany would also like to support the LDN Initiative by providing an additional €100,000 for its development. Sustainable management of the land and strengthening participation of Global South countries was of great importance to Germany, and it hoped that other GEO Members states and POs would also support the LDN Initiative.

Spain supported Switzerland's comments on the need for common view on essential variables. Spain also called for greater coordination of in-situ data, citing the need for high-quality in-situ data for environmental monitoring.

The EC supported the update of the 2017-2019 Work Programme, and welcomed the Arctic GEOSS Community Activity. The EC appreciated the evolution towards a more knowledge-oriented emphasis for GEO and would continue to promote the key role that GEO can play in support of global policy initiatives. In this context, the EC would maintain its contribution of €1 million in 2019.

Italy agreed with the comments of Switzerland, noting that essential variables can be relevant in support of, and achieving, global policy, so some degree of coordination would be beneficial. Italy requested whether activities of the Blue Planet Initiative and the Marine BON (MBON) component of GEO BON were linked. Finally Italy noted an apparent mismatch in terms of the proposed budget verses Secretariat resources allocated to certain Foundational Tasks, such as user engagement.

Mr Larlee responded that there had been changes in the allocation of Secretariat resources, and the intent was to align them with the priorities set by the new Director. He also noted that Secretariat resources had diminished over the past year and were not sufficient to cover coordination of all Foundational Tasks. Finally, MBON was viewed as the marine ecosystem component of Blue Planet, contributing to both it and GEO BON.

Noting no objections, the Chair announced that the update to the 2017-2019 GEO Work Programme had been approved.

5.4 Timing of the Mid-term Evaluation

The Chair informed Plenary that, in the interest of informing development of the 2020-2022 Work Programme, the Executive Committee recommended Option 1 for the mid-term evaluation process, meaning it would start in January 2019.

No objections were noted and Option 1 for the timing of the Mid-term Evaluation was approved.

5.5 Approval of Slate of 2018 GEO Programme Board

The Slate as recommended by the Executive Committee, containing representatives from 16 Members and 16 Participating Organizations for a total membership of 32 was approved.

6 New Paradigms for Global Interdisciplinary Science

Mr Michael Obersteiner, Head of Ecosystems Services and Management, International Institute for Applied Systems Analysis (IIASA), gave a presentation entitled “Science as a Bridge”. Regarding achievement of the SDGs, he started by noting that changes in emission budgets caused by permafrost carbon release is not well captured and is a source of great uncertainty in calculated carbon budgets. GEO is the key towards achieving SDGs through increasing access to Earth observations in order to help with reducing uncertainty. In the transition to the digital economy, two different data ‘policies’ can be followed in responding to global initiatives: the first is the more traditional ‘manual policy’ based on aggregation of statistics, expert surveys, cost-benefit analyses, national plans and a ‘gut-feeling’. The second the ‘algorithmic policy’ aims to exploit advances in technology including Earth observations, data cubes, crowd-sourcing, policy-impact models, national narratives and the field of politico-analytics. The sheer amount of big data being produced, combined with the complexity of responding to the reporting requirements of global policy such as the SDGs, calls for a shift to algorithmic policy-making. In the case of Brazil, algorithmic policy-making involved use of the Global Biosphere Management Model (GLOBIOM) in order to analyse the competition for land use between agriculture, forestry, and bioenergy, the main land-based production sectors. The model was able to provide scientists and policymakers with the means to assess, on a global basis, the rational production of food, forest fibre, and bioenergy, all of which contribute to human welfare. Mr Obersteiner summarized his presentation by observing that, at present; the absorptive capacity for policy processes enabled by Earth observations is limited, and thus called for building a new culture of a “geo-spatial digital democracy” in order to bring about true transformation. GEO must build the observational historical record for these sophisticated data analytics tools which are only emerging and can feed algorithmic policy-making. However, creating lasting impact on global policies with Earth observations is a process that requires large scale investments today in Earth observation infrastructures, while benefits are often realized only over the longer term.

Mr Hiroshi Yamakawa, President of Japan Aerospace Exploration Agency (JAXA), provided an overview of recent achievements by JAXA. He informed Plenary that the new Greenhouse gases Observing SATellite (GOSAT-2) had been successfully launched on 29 October 2018. He explained that it was JAXA's next generation satellite, a follow on to the original GOSAT mission (launched in 2009), and would provide much more accurate measurements of atmospheric concentrations of major greenhouse gases such as carbon dioxide (CO₂) and methane (CH₄). Deployment of the Hayabusa2 asteroid explorer in 2014 had resulted in a successful rendezvous with the asteroid in June of this year. It is currently carrying out surveys prior to its planned return to Earth in December 2020. JAXA's Mercury Magnetospheric Orbiter is currently providing a detailed description of Mercury's magnetosphere and of its interaction with the planetary magnetic field and the solar wind. The joint Japan International Cooperation Agency (JICA) – JAXA JJ-FAST project is contributing to global tropical forest and biodiversity conservation and climate change mitigation by using satellite technology and multi-stakeholder partnerships. The Advanced Land Observing Satellite (ALOS-2) with its Phased Array type L-band Synthetic Aperture Radar (PALSAR-2) sensor are providing PALSAR-2 observations for the polar regions, and recently monitored detachment of a large iceberg from Larsen-C Ice Shelf in the Antarctic Peninsula. The Global Rainfall Map (GSMaP) uses the JAXA Global Rainfall Watch System to produce hourly rainfall, 3-, 12-, 24-, and 72-hourly cumulative rainfall amounts, based on the combined microwave-infrared data from NOAA and MetOP satellites, and the GSMaP (Global Satellite Mapping of Precipitation) project. The Global Change Observation Mission (GCOM-C) conducts surface and atmospheric measurements related to the carbon cycle and radiation budget, such as clouds, aerosols, ocean colour, vegetation, and snow and ice. JAXA is actively involved in provide remote-sensing in support of the Sentinel Asia programme, an international collaboration involving space, disaster management, and international agencies for applying remote sensing and Web-GIS technologies to support disaster management in the Asia-Pacific region. Since 2007, it has responded to emergency requests for Earth observations for 282 disasters across 29 countries/regions. Mr Yamakawa concluded his presentation by observing that, through a variety of freely available satellite observation data and integrated information products, JAXA is focusing on environmental monitoring globally, including sharing of technology with emerging countries.

Mr Stuart Minchin, Chief of the Environmental GeoScience Division, Australia, gave a presentation on "Digital Earth Africa: Open Data Cube Science for Sustainable Development". He prefaced his remarks by noting that satellite programmes have been producing large volumes of data, measuring environmental parameters of the Earth for 40 years, and yet these data have not been exploited to their full potential. Australia has been capturing Landsat data

since 1977 across the continent, and its solution to mining remotely-sensed big data was the data cube in which satellite images, auto-rectified pixel by pixel, could be stored digitally so as to permit time-series analysis of certain environmental characteristics. Algorithms have been developed to examine, for example, changes of water extent, land cover, mangrove expansion and coastal erosion. Each of these algorithms was underpinned by extensive scientific research, and where results were obtained by satellite retrievals, these were validated by in-situ observations and campaigns. The data cube concept can be transferred to other countries and regions around the world, and a growing network of compatible open-source data cubes is developing. A data cube for Africa (Digital Earth Africa) is one such example, involving the nations of Botswana, Cote d'Ivoire, Ethiopia, Gabon, Ghana, Kenya, Malawi, Rwanda, Senegal, Sierra Leone, South Africa, Tanzania, and Uganda. Work related to building drought resilience for Tanzania is being applied across the region. Other uses cases are being developed for time-series monitoring of agriculture, land degradation, water quality and extent, disease/pests outbreaks, deforestation, illegal mining, urban growth, flood risk, unplanned settlements, wildfires, mangroves, landslides, and support for SDG monitoring and achievement frameworks. Mr Minchin concluded by underscoring the fact that robust science underpinned the operational products being delivered through the open data cube, planned for development through Digital Earth Africa, and elsewhere.

Norway asked about open access to satellite data from JAXA, to which Mr Yamakawa responded that data from GCOM-C will be made open and freely available, and that data from other Earth observing satellites were already fully accessible from the JAXA website.

Finland noted that the time-series images presented in the data cube presentation were powerful, and they should be used as marketing tool to convince the governments paying for the satellite programmes of the utility of the observations.

The US agreed that the value of Earth observations, as demonstrated by the presentations of this session, need to be communicated to policy makers and the international community.

7 Earth Observations in Support of the Sendai Framework

7.1 Panel Discussion

This Panel session presented Plenary with an overview of GEO's activities supporting the Sendai Framework. The four phases of the disaster cycle include prevention, preparedness, response and recovery. Currently Earth observations are used less for prevention and preparedness where the biggest savings are in terms of lives and money.

The panellists included:

- Mr Renato U. Solidum, Undersecretary for Disaster Risk Reduction and Climate Change Adaptation, Department of Science and Technology, Philippines
- Mr Nate Smith, Director, Technology and Innovation, Humanitarian OpenStreetMap Team (HOT)
- Mr Lin Hui, Chinese University of Hong Kong
- Ms Joy Jacqueline Pereira, Professor and Principal Research Fellow SEADPRI University Kabangsaan Institute for Environment and Development

Moderator: Mr Toshio Koike, Director International Centre for Water Hazard and Risk Management (iCHARM).

Mr Koike prepared the discussion by reminding Plenary of the seven goals of the Sendai Framework, which are to substantially:

- reduce global disaster mortality;
- reduce the number of affected people;
- reduce disaster damage to critical infrastructure;
- increase the number of countries with national and local DRR strategies by 2020;
- enhance international cooperation;
- increase the availability of and access to early warning systems; and
- reduce direct disaster economic loss.

He also recalled the threefold application for disaster-related EO data proposed earlier by Ms Mizutori (UNISDR), which were: assisting countries to assess current risk trends with a view to determining the most pressing priorities; filling gaps which currently exist in official statistics and helping to provide a comprehensive picture of the status of implementation of the Framework; and contributing to UNISDR's efforts in building a collaborative Global Risk Assessment Framework (GRAF), an interactive platform driven by the needs from national or local

government to cities, towns and villages, and developed by a user-centric, co-development approach. Priorities for action should thus: center on understanding disaster risk, strengthening disaster risk governance to manage disaster risk; investing in disaster risk reduction for resilience; and enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation and reconstruction. Finding a platform that would permit data providers and governments to work together, include local stakeholders in a co-design and co-production mode, and build on interdisciplinary/transdisciplinary research making use of big data analytics was essential to adequately respond to the goals of the Sendai Framework. The Data Integration and Analysis System (DIAS) developed by the University of Tokyo, Kyoto University, Nagoya University, the National Institute of Informatics (NII) and the Remote Sensing Technology Center of Japan (RESTCE) are one such platform. In the Sendai Framework context, the Japan DIAS provides integrated risk assessment for policy-making, using environmental, geohazard, vulnerability and socio-economic data and information as inputs, and examining they can both influence, and be influenced by climate and societal changes. The Japan DIAS has been used successfully in GEO-related projects such as the Asian Water Cycle Initiative (AWCI) and the African Water Cycle Coordination Initiative (AfWCI).

Mr Solidum explained that the Department of Science and Technology (DOST) of the Philippines has developed a research and development agenda related to disaster resilience. The agenda considers national disaster risk reduction and climate change action plans and responding to global initiatives such as the Sendai Framework, Sustainable Development Goals and Paris Agreement. The agenda is divided into two major themes and Earth observations play a major role in both: the first involves the Understanding of Risk. Earth observation is important in monitoring and forecasting, in exposure data development, hazards and risk assessment and in warning and risk communication; the second is to develop and provide technology solutions, products and services in the various phases of disaster risk reduction and management and climate change adaptation and mitigation. Earth observations have been used in response and recovery efforts in past disasters in in the Philippines, and as more data are being gathered from various efforts, there is a need to integrate data, have it evaluated, and the results shared so decisions at the national to local level are informed. Monitoring data, along with hazard and risk information, must be transformed into understandable and actionable information or products that can be easily accessed through web and mobile platforms so that concerted efforts at the national-to-community levels may make use of that information to reduce risk and effectively and efficiently manage disasters.

Mr Smith spoke on how the Humanitarian OpenStreetMap team is leveraging citizen data partnerships and making use of Earth observation data in support of

the Sendai Framework. In particular, citizen generated data for response and preparedness activities, and building partnerships for work across the disaster risk reduction cycle are key elements in their approach. Earth observation data is distributed through the OpenAerialMap product; both OpenStreetMap and OpenAerialMap have ecosystems of tools and methods that can work well in managing citizen-generated data, but increased investments of time and resources are needed if these are to be strengthened.

Mr Lin presented work being done on urban monitoring in China. He noted that the urbanization rate in China will be up to 70% by 2050, and infrastructure investment will be 40-45 trillion RMB during this period. When local governments hit the “red line” set up by the central government on farmland and ecosystem protection, they started to explore underground and semi-underground spaces for construction. However, there is an increasing risk of the ground deformation caused by underground and semi-underground constructions which must be closely monitored. The Chinese University of Hong Kong has been developing an urban sensing platform consisting of Space-Sky-Ground integrated components (satellites, ground-based sensors) to establish an early warning system for ground deformation. The system has been used successfully to monitor subsidence at the new Hong Kong International Airport, built on reclaimed land in the surrounding bay.

Ms Pereira spoke aspects of multi-hazard disaster risk forecasting for Kuala Lumpur, Malaysia. She commented that the scales of information for decision-makers could vary considerably, depending on the intended purpose. On the large end were data and information from satellite imagery, digital elevation models, and topographic/geological maps. On the more granular scale were household surveys and crowd sourcing. In terms of applications, open source data tended to be of limited usefulness for information at local scale. Development of a multi-hazard platform for disaster resilience required knowledge integration for identifying climate and socio-economic drivers, emerging hazards, vulnerability and exposure, and to frame current and future risks for preventing disasters. It also required institutional linkages for investment and coordinated action, in order to implement early warning systems, land-use control, preparedness, response, recovery and iterative adaptation.

The Moderator then opened the floor for questions.

- Q: Where does the data come from that is available through OpenAerialMap, and how is data quality controlled?
 - Mr Smith responded that it comes through many sources and the quality control is in hands of user; there are no mechanisms to systematically check for quality.

- Q: How is licensing dealt with in the OpenStreetMap project? Does this represent a burden for integration with authoritative data?
 - Mr Smith responded that there are no restrictions. Google and others all make use OpenStreetMap, and there is no issue with combining data from various sources.
- Q: The Philippines have been hit with several natural hazards lately, what countermeasures have been taken, and which are most effective?
 - Mr Solidum answered that different types of hazard risk maps had been created for the government, for specific threats, and that these were very useful in deciding where to construct buildings and infrastructure. Also, having a ground station to directly receive satellite data in the wake of a disaster was of critical importance.
- Q: All presenters gave good examples of how Earth observations are being used in your particular area. What should the GEO community do to better support the Sendai Framework?
 - Mr Solidum answered that satellite images are needed as soon as possible after a disaster event. Strengthening collaboration and capacity building were also important, to learn how to generate and properly use maps of risk.
 - Mr Smith replied that providing greater access to observational databases would be helpful. Also, OpenStreetMap would like to serve as a resource for learning and training, understanding how to map and tag attributes how items are named.
 - Ms Pereira offered that the issue of scale is important for decision-making and often the map resolution for land cover management was not a good fit for decision-makers. Getting good data quality was also important.
 - Mr Lin responded that there was a need for combining more socio-economic data with risk mapping, especially in built-up areas that are more susceptible to hazards. Perhaps crowd sourcing might be way to provide this type of data. He added that help was needed with monitoring fast-growing urban areas where infrastructure was often not inadequate for coping with growth, and in addition was subject to natural and man-made problems. He called for partnerships with scientist and engineers, as well as the commercial sector to better address urban issues and city planning.
- Q: What types of partnerships are needed to promote the use of Earth observations nationally?

- Mr Solidum suggested that working with departments of science and technology could help with coordination on major national infrastructure projects, such as building roads and bridges. Also, Earth observations could assist agencies who use statistics in the estimation of loss damages, especially in remote areas.
- Q: How can Earth observations supplement statistics in national reporting?
 - Mr Smith cited the example of the Ministry of Health in Botswana which was working with several partners to collect baseline census and demographic data by means of household surveys for malaria elimination. Given the availability of open data sets, the challenge was how to merge the two (or more) different data streams.
- Q: Given the tremendous number of needs, how can work be prioritized?
 - Mr Smith responded that making community baseline data easily accessible through openly available maps would be a good way to start.
- Q: What ideas do you have in terms of developing a science and policy platform?
 - Ms Pereira thought that such a platform could be useful for providing support to national disaster management agencies. Science could help with the kinds of monitoring systems that needed to be put in place. Citizen science could become involved in monitoring hazards – possibly in near real time – which would further enhance the value of the information coming from the platform, although there would need to be some type of systematic quality control in place (a role for the commercial sector?).
- Q: How can statistical information be integrated more systematically with information being produced by monitoring systems?
 - Mr Hui responded that a better understanding of the kinds of data the government needs in policy reporting – and where the gaps may lie – would be a place to start. Remote sensing can help bridge the gap between reporting and statistics in a more quantitative way. Research and long-term observations (radar images) can also exert an influence regarding future construction of urban sites, maintenance and appropriate building materials. The Sendai framework is about risk and early warning, which means proper attention must be given prior to disaster striking, and only the correct observing systems can provide the information needed.

- Q: What are the best ways for countries to develop their strategy with respect to reporting on disaster risk reduction?
 - Mr Solidum noted there were many working groups under UN auspices that a government could collaborate in defining agendas for the Sendai Framework, as well as post-disaster needs assessments.
 - Mr Smith suggested forging closer partnerships with universities and research groups.
 - Mr Pereira noted that the national disaster agency of Malaysia had drafted a disaster risk reduction plan which featured the use of Earth observations as a first step for planning against hazards.
 - Mr Hui agreed that partnerships between the government and universities and research agencies were important. While the commercial sector also has a role to play, a key objective should be to make certain citizens truly benefit from planning for disaster risk reduction.

7.2 Panel session outcomes and recommendations

1. There is an opportunity for the GEO community to respond to the Sendai Framework (across disaster cycle) while helping to develop the Global Risk Assessment Framework (GRAF).
2. GEO community can work together to assess current risk trends with a view to determining most pressing priorities for national and local DRR strategies by 2020.
3. Fill gaps which exist in official statistics to help provide an overview of the status of policy implementation: UNECE, UNESCAP, UN-GGIM & UNISDR work on disaster-related statistics.
4. The discussion around risk is changing. EO data and information can provide better assessments, identification, monitoring and prediction of hazards to 'Build Back Better'.
5. Invest in areas where users and partners can collaborate with citizen generated data, and leverage these partnerships to implement preparedness and strengthen capacity for response.
6. In-situ observations are as important as spaced-based observations for the Sendai Framework. There should be a strong link between the two; the GEO Work Programme should reflect this.

8 The Future of GEO

8.1 A strategy for a results-oriented GEOSS

Secretariat Director, Gilberto Camara, presented Plenary with his vision for a results-oriented GEOSS. He started by illustrating the fundamental challenge currently facing humanity, which is how to provide food, water and energy for a population of 9.4 billion while avoiding dangerous climate change and protecting our planet's biodiversity. The landscape is crowded with many agencies working on these questions, so what should GEO's unique role be? He noted that, through the GEO Strategic Plan and several Ministerial Declarations, that GEO has a mandate which includes GEOSS being an information technology enabler as well as delivering access to Earth observations. Further, GEOSS should provide knowledge on how to integrate not only physical measures of the planet (through direct Earth observations), but also measures of human actions (through indirect Earth observations). He stressed the importance of viewing GEO as being closer to the Linux or Wikipedia communities, which represent a commons-based approach to the peer production of knowledge based on the wealth of networks, rather than as simply a 'voluntary' organization, subject to a wide variety of interpretations. In the case of sustainable development, it was important to identify who has the authority to make decisions, and how those decisions are made. GEO's vision is for a future wherein decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observations. Thus knowledge that informs us about the limits of our planet is critical in order for societies to take actions on deciding how to use our planet's resources wisely. Reliable knowledge communicates its discoveries to society in a socially robust and reusable way, which means it is based on research that is interdisciplinary/transdisciplinary, open and replicable, as well as co-designed and co-produced with local stakeholders and end-users.

He continued that the GEO Work Programme has a lot of activities with potential to be scaled up. However, the big question was how to actually take them to the global level. Institutions are the key, as well as an approach that fosters trust, which means that co-design and co-productions are essential components of any methodology. He illustrated how the world in general, especially the Global South, is becoming more educated, which is turning the usual way of doing things on its head. There is a new digital economy featuring low cost access to web services and cloud computing, and there is no turning back. An example of this new digital economy is the proliferation of big data analytic tools such as Google Earth Engine, indicating that Silicon Valley has taken note of open access to Earth observations. However, a drawback of Google Earth Engine is that there is no public input on the datasets featured, nor is there any long-term curation of that

data. In the new digital economy, the Global South will only use Earth observation information that is free at the point of access. Experts of the global community will need data, web services and cloud computing architectures in order to produce knowledge that can be shared and reused.

Therefore, in response to the challenges for GEO outlined at the beginning of his presentation, Mt Camara suggested the niche for GEO is to scale up activities and projects of its Work Programme to the global level. Further, GEO must produce knowledge through its activities that is trustworthy, robust and reusable, especially for countries of the Global South. Embracing the digital economy is the way to move forward to achieve this objective. He cited the open data cube effort as an example of providing an open source solution for big Earth observation data analytics that was fully aligned with this strategy, along with the collective GEO effort to build an application library of interchangeable data analysis methods. A results-oriented GEOSS would further feature a database of openly reusable information from scientific reports and executable papers, along with curated in-situ data sets, that would ultimately make GEO a trusted repository of knowledge and learning. He concluded his presentation by announcing that GEO had negotiated US\$ 1.5 million in cloud computing credits with Amazon Web Services, to be applied towards projects submitted from the GEO community that demonstrated the above attributes and worked to contribute to the results-oriented GEOSS. The Secretariat would be issuing a Call for Proposals in the coming weeks in which successful applicants would be awarded US\$60,00 to \$100,000 in cloud computing credits over three years, depending on the number of countries involved in a given project.

China asked whether other types of data obtained from satellites, such as communications or global positioning, would be integrated through GEOSS along with Earth observations.

Mr Camara responded that GEO's mandate did not include information from communications and positioning satellites. The strict definition in GEO documentation referenced data and information from sensors measuring some physical property of the Earth's surface or atmosphere, forming part of public sector, and this mandate should be strictly adhered to.

The EC expressed gratitude to Mr Camara for developing this new strategy for GEOSS. The presentation helped Plenary understand that the proposed transition for GEOSS was not yet a finished product, but more a work in progress which will need further consultation with relevant stakeholders. The objective of the new vision for GEOSS had been clearly presented, a system wherein data and information are fit for purpose for users and decision-makers. The EC urged that the new GEOSS be built on what already exists, including the Discovery and Access Broker (DAB) rather than starting from scratch.

Mr Camara responded by noting the deepest respect for work done by ESA, JRC and CNR, and agreed on the need to find ways to improve what currently exists. He wanted to see the transition occur as smoothly, rather than create any ruptures.

Japan wished to hear more about the Secretariat Director's views on co-design and co-production.

Mr Camara responded that, having just attended the GEOSS AP Symposium the previous week, he was impressed with the work being done by the International Centre for Water Hazard and Risk Management (ICCHARM). He viewed it as a model on how to go forward, having achieved a high level of co-design in many countries for drought monitoring. The involvement of the Japan DIAS in ICCHARM showed how local stakeholders and end-users can be involved in the co-design and co-production phases, while providing a means to scale-up activities to other regions.

The US noted that the Director's presentation mentioned the importance of in-situ data, that it is a challenge to obtain these data and make them available, as well as integrate them with remote sensing information. The US wanted to know what role the Secretariat would play in this regard, what next steps the Director envisaged.

Mr Camara responded that in-situ datasets were directly linked to work of GEO Flagships and Initiatives. The Secretariat would work towards setting up an environment in which the GEO community can use in-situ data via cloud services, which will promote data sharing. The Global South may be convinced to share data when they see others doing so, and that data sharing ultimately enhances job execution and completion. The Secretariat would be looking towards establishment of 3-4 data repositories, in collaboration with institutions who have a commitment to build in-situ databases for GEO. The creation of in-situ data repositories where data are archived, curated and maintained represents a serious commitment to making a difference in the world. Mr Camara thanked Germany for providing resources to hire a full-time in-situ data expert at the Secretariat.

Mexico enquired about data quality and interoperability standards for data in the in-situ repositories.

Mr Camara responded that these were indeed important issues, given several instances of faked results had been recently highlighted in scientific journals. He suggested that, while not within GEO's mandate to issue prescriptive standards, much could be done to ensure data quality, such as performing a 'gatekeeper' function with data submitted to the repository. Part of data curation included

making certain that providers fully described their data, while retaining the flexibility to make judgements on the quality.

Finland was not certain how realistic it will prove to be to create in-situ data repositories, considering that, for example, large amounts of meteorological data are already being stocked by weather bureaus globally. There were other issues that needed to be thought through, such as the application of Digital Object Identifiers (DOIs). Nevertheless, Finland fully supported in principle the concept of creating in-situ data repositories.

Italy wondered, knowing that most in-situ data collectors have their own repositories and that some are openly accessible, what the added value would be for GEO to try to centralize all existing repositories, and how issues around having open policy for those who do not yet share data would be resolved.

Mr Camara answered that some kinds of physical parameters, such as deforestation, cannot be measured by directly by sensors, but only through on-site monitoring. In-situ data are also valuable as a means for not only supplementing monitoring for the SDGs, Paris Agreement and Sendai Framework, but also for validating data derived from remote sensing. Therefore, there is a need for conveniently storing the in-situ data needed to meet reporting requirements for major policy agreements. It is not simply a question of going through a broker and finding data, rather having trusted data that is authoritative for answering policy questions. Advocating the benefits to society by being part of a trusted repository for in-situ data would be one approach for opening access. In terms of promoting an open data policy, no one was more committed to that than he.

9 GEO Business

9.1 2017 Financial Statements and Audit Report

Ms Virginia Burkett, NOAA, addressed the 2017 Financial Statements and Audit Report, noting that the timing of the reduction of contributions in 2018 coming late in the year meant that expenditures could not be reduced sufficiently to avoid a deficit. This deficit meant that the working capital fund was drawn down, though noting that the fund was designed specifically for use in such circumstances. Despite these factors, the Audit Report provided GEO with a clean bill of health financially.

9.2 Proposed 2019 GEO Trust Fund Budget / Pledges and approval

Ms Burkett noted that the 2019 Proposed Trust Fund Budget was based on assumptions of cash contributions of CHF 3.7 million and in-kind contributions of CHF 1.55 million. Modest growth is forecast in out-years reflecting increasing costs.

Mexico indicated it would increase its contribution for 2019.

Germany noted the Secretariat 2019 budget included an increase of CHF 30,000 for travel, and wondered if there would be support for moving meetings of the Programme Board outside of Geneva.

Sweden announced it would provide the same level of contribution to the Trust Fund in 2019 as in 2018 (CHF 110,000).

Italy noted no resources had been allocated for the Expert Advisory Group (EAG). Italy was also trying to reconcile descriptions of Secretariat activities with resource allocations (no support mentioned for GEOSS Platform).

Australia pledged AU\$ 170,000, and would continue working with the Budget Working Group (BWG). With respect to Germany's concerns, Australia noted that travel had been cut considerably in order to accommodate a very restricted budget the past few years, whereas the 2019 budget was aiming to bring the travel budget back up to normal levels.

China commented that it would strive to increase its contributions for activities of the Asia-Oceania region.

Japan indicated it was prepared to contribute as much as possible for 2019, and that it planned to continue support for a seconded expert to the Secretariat.

The Secretariat Director noted that an increase in travel expenses for the Secretariat was anticipated due to the 2019 Ministerial and Plenary being held in Australia. Regarding the allocation of staff resources, it was the duty of the Director to allocate staff in way that best fits with the priorities of GEO. As an example, the Programme Board has asked the Secretariat to take a close look at activities of the Work Programme, which has required a reallocation of staff members so that the Secretariat can adequately respond. The Board has been very pleased with the result and has expressed this to the Executive Committee. With respect to moving meetings of the Programme Board away from Geneva, the Secretariat has decided instead to allocate resources to support travel for participants from developing countries to come to Geneva. In general, the Secretariat is working to be judicious, travelling only when necessary.

9.3 Update of the GEO Rules of Procedure

The update to the GEO Rules of Procedure, with the exception of language pertaining to the creation of the GEO Associate category in Article 2 and Annex A and its Appendices, was approved.

9.4 Announcement of 2019 Lead Co-Chair and Slate of 2019 Executive Committee Members

The 2018 Executive Committee will include the following Members:

- Africa: South Africa (Co-Chair and Lead Co-Chair for 2019), Morocco, Senegal;
- Americas: USA (Co-Chair), Argentina, Ecuador;
- Asia-Oceania: China (Co-Chair), Australia, Japan, Republic of Korea;
- Europe: European Commission (Co-Chair), Germany, Italy, Switzerland.

9.5 2019 Ministerial and GEO-XVI Announcements

The Chair announced that Australia has offered to host the 2019 Ministerial and GEO-XVI Plenary in Canberra the week of 4-9 November 2019. A video welcoming the GEO community was then showed by the delegation from Australia.

The Chair expressed appreciation for the offer and was pleased to accept on behalf of Plenary.

9.6 Any Other Business

None.

9.7 Session Outcomes

Mr Douglas Cripe, Secretariat Senior Scientist, highlighted the outcomes of each of the Sessions of the Plenary agenda in his presentation.

9.8 Closing Remarks

Secretariat Director Mr Gilberto Camara thanked the government of Japan for their hospitality and excellent hosting of the GEO-XV Plenary. He also thanked the GEO Co-Chairs and Secretariat for their hard work and commitment, which he felt certain will produce results in the near term.

The USA Co-Chair, Mr Stephen Volz, found that the Plenary had been excellent right to the very end, and was pleased how easy it had been to work together with everyone. He noted that GEO was expanding to include the new Associate category, and that there was much work to be done since the upcoming year will

be a challenging, busy one. He remarked that the Secretariat had brought a new vision for GEOSS with a focus on delivery and was confident that the Programme Board working with the Secretariat would be able to show progress along these lines.

The EC Co-Chair, Mr Patrick Child, expressed gratitude to Japan for efficiently hosting a complex meeting. He said the EC continued to be a strong supporter of GEO, and he was personally happy to have attended his first Plenary. He felt substantive work was being accomplished and was pleased that everyone resisted the temptation to become bogged down in lengthy discussions. He was very much looking forward to working together with the GEO community on achieving the lofty ambitions of the priority policy agreements. He was also looking forward to working with the Secretariat Director in realizing the noble ambitions for GEO as expressed in his presentation. He emphasized the need to work in a practical way, building on successes GEO currently has, and keeping in mind the need to convince Ministers over the next few months to come to Canberra for the 2019 Ministerial, based on outcomes that lead to useable results. He concluded by stating he was encouraged by the Plenary meeting and was convinced more than ever of importance of Earth observations.

The Chinese Co-Chair, Wei Huang, his fellow Co-Chairs and the Secretariat Director for a very successful Plenary. He felt that truly solid efforts had been made, noting that all agenda items had been completed, the Terms of Reference for the Regional GEOs had been revised, and that the discussion for the development of GEOSS, as outlined in the results-oriented presentation, had been constructive. He wished to thank the government of Japan for their excellent hosting, and the Secretariat for their hard work. During 2019, China would continue to perform its duty as Co-Chair, making contributions to the GEO Work Programme, and looked forward to working with South Africa as Lead Co-Chair in preparing the 2019 Ministerial.

The South African Co-Chair, Mmboneni Muofhe, thanked his fellow Co-Chairs for work accomplished, and for making this a successful Plenary. He also thanked the government of Japan for expertise in hosting the meeting, as well as the delegates who came to the Plenary, noting though they represented many national agencies and organizations, the contributions they were making to GEO were tangible and appreciated. He thanked the Secretariat and its Director for their hard work, reflected in the content and timing of the Plenary documents. He observed that it was going to be a very busy year ahead, with work continuing to mobilize resources for GEO, and making sure that all stakeholders are included and engaged as much as possible. He hoped the work on resolving outstanding issues with respect to the GEO Associates category would begin in earnest, and finish successfully.

The final word went to MEXT State Minister, Ms Keiko Nagaoka. She commented that it was an honour for her to deliver the closing remarks and expressed appreciation for the many practical discussions over past few days. She observed that GEO had been developing constantly, providing many practical solutions and scientific output for global issues. She was pleased to see that, since first Earth Observation Summit held in 2003 when the original concept of GEO was first floated, GEO had continued through to the present to be primarily an intergovernmental partnership. She appreciated how GEO was facing the future and evolving through use of innovative ideas with respect to science and technology to respond to rapidly changing societal challenges. She thanked the Co-Chairs for the fruitful discussions, all Members and Participating Organizations who attended and contributed to the discussion, and the Secretariat Director and staff for organizing the Plenary. She looked forward to meeting everyone again next year in Canberra.

Meeting adjourned at 6:00 pm.

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GEO-XIV

31 October – 1 November 2018

Kyoto, Japan

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