Copernicus for SDGs, International Agreements and Conventions

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Workshop Report

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1 INTRODUCTION

In 2015, the members of the United Nations adopted a set of ambitious **Sustainable Development Goals (SDGs)** in the framework of the 2030 Agenda for Sustainable Development. These goals aim to address the world's most pressing challenges over the next fifteen years, such as ending poverty, protecting the planet and ensuring prosperity for all. In order to measure and monitor progress towards the 17 SDGs and 169 associated targets, the UN has established a global list of indicators which will serve as a common benchmark for regular reporting of progress. Each target has between 1 and 3 indicators used to measure progress toward the targets.

"Earth Observation offers unprecedented opportunities to modernise national statistical systems and improve the capacities of countries to efficiently track all facets of sustainable development. **Satellite data has a role to play in relation to most of the 17 Goals and around a quarter of the Targets**" (Satellite Earth Observations in support of the Sustainable Development Goals, 2018).

The Copernicus programme is a powerful instrument to support the reporting on these SDG indicators and the provision of relevant information to effectively monitor progress towards the SDG targets, and degree of compliance with the International Agreements. The unprecedented amount of **data and information generated by Copernicus supports decision-makers in developing adequate policies** to achieve the goals and facilitates the monitoring of the SDGs and International Agreements. It is available on a full, free and open basis, which reduces the cost of monitoring SDG indicators. It also allows for the development of operational products and services.

In the international context, the EU and its Member States are also Parties to many **multi-lateral environmental agreements** which address: biodiversity and nature protection, climate change, desertification, management of chemicals and waste, transboundary water and air pollution, industrial accidents, maritime and river protection, environmental liability, and many others. As signatories of the treaties, the EU and its Member States are committed to abide by the obligations stemming from the treaties and conventions, but the EU is also committed to help developing countries in meeting their obligations. The implementation and monitoring of these agreements are highly dependent on the quality and regularity of the available information.

The systematic provision of Earth Observation data and information by Copernicus assists governments and stakeholders in developing strategies and actions to assess, track and reach the goals that are formulated in these different International Agreements/conventions (Examples of these agreements include the Ramsar Convention on Wetlands, the United Nations Convention to Combat Desertification, the United Nations Framework Convention on Climate Change to name a few). As for the SDGs, Earth Observation is an essential tool to help meet reporting and information gathering obligations.

Against this background, the Copernicus' support for SDGs and International Agreements' Industry Workshop had the following objectives:

- to demonstrate the role of EO data and information in support of the assessment of the progress towards achieving the SDGs, in response to the needs of international conventions/agreements
- to highlight the potential contribution of the Copernicus free and open data, and services' information products;
- to present and discuss the potential evolution of Copernicus services in the context of SDGs and International Agreements.

The workshop was organised around 4 sessions featuring Climate Change, Marine, Land and Inland Waters and Atmosphere (and their related SDGs and International Agreements).

All materials can be found on the following web pages:

- Event: https://copernicus4sdgs.eventsite.be/page/82/Home/
- Presentations: https://copernicus4sdgs.eventsite.be/page/83/Material/
- Recording of the event: https://webcast.ec.europa.eu/copernicus-workshop-on-copernicus-contribution-to-sustainable-development-goals-and-international-conventions-agreements
- Copernicus website: https://www.copernicus.eu/en/copernicus-support-sustainable-development-goals-and-international-agreements-industry-workshop

2 CONCLUSIONS

2.1 Proceedings

2.1.1 Setting the Scene - Copernicus EO data and information in support of the SDGs

In the opening remarks, Ms **Elisabeth Hamdouch** (deputy-head of the Copernicus unit, DG GROW) stated that Copernicus truly is a global player, which is legally reflected in the current Copernicus regulation as well as in the follow-up piece of legislation, in which the Copernicus programme is part of a broader regulation on the Space policy programme of the European Union. This new Regulation is fully in line with the communication from the Commission of 26 October 2016 to implement the Union Space Strategy for Europe by putting the Union's space programme on a firm and stable footing during the 2021-2027 financial framework. In the Space strategy, there also is a clear commitment to foster a globally competitive and innovative European space sector, to reinforce Europe´s autonomy in space, and to strengthen Europe's role as a global actor as well as to promote international cooperation. One of the 4 foundational pillars of this strategy is the international dimension, recognising that the EU (and therefore Copernicus) needs to be a strong actor in Space at the international level and that many of the global challenges can only be addressed with strong international partnerships.

The Space strategy refers to the importance of the stability of the Union´s space programme and long-term commitment and then, in this context, specifically for Copernicus, it means:

- Continuity + Enhanced continuity of current data and services
- Continuity of full, open and free data and information policy

Furthermore, it was stressed that Copernicus' continuity and its full, free and open data and information policy, are crucial to derive geostatistical metrics to measure the SDGs. Driven by the EU's international commitments and policy needs, Copernicus will keep delivering and improving its information products for decision-making applications.

Mark Dowell (DG JRC) introduced Copernicus, and its unique characteristics as a user- and EU-policy driven programme in the context of SDGs and international conventions. According to Mr Dowell, additional services from Copernicus will be considered to meet emerging needs covering climate change and sustainable development, the monitoring of CO_2 and other greenhouse gases, changes in the Arctic, and land use and forestry.

Copernicus' international dimension was already present in its original Regulation (377/2014) and was mentioned as one of the four pillars of the Space Strategy (2016). This is reinforced in the current Proposed Regulation for a Union Space Programme. Such international scope includes links to GEOSS (the Global Earth Observation System of Systems) and CEOS (the Committee on Earth Observation Satellites), but also to the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) and the Sendai Framework for Disaster Risk Reduction, to which Copernicus should be considered as a European contribution. EuroGEOSS, in addition, has a specific focus on the SDGs and advocates a shift from a data-centric approach to a user-driven GEOSS.

When it comes to the SDGs, Copernicus offers a series of products and services which contribute to their monitoring, ranging from the Copernicus Maritime Environment Monitoring Service (CMEMS) ocean acidification product to Copernicus Climate Service (C3S) contribution to the Global Climate Observing

System (GCOS). In addition, Horizon 2020-funded projects are exploring the potential of a Copernicus CO_2 emission monitoring capacity.

Thomas Stefan Klein (Swedish Agency for Marine and Water Management) presented Sweden's new National Land Cover Database (NMD), supporting environmental, societal and emergency planning; effective and efficient management of resources; and mitigation and adaptation to climate change. The NMD is driven and co-funded by a variety of stakeholders for additional expertise and validation, including Statistics Sweden. The database covers 24 classes with a 10x10 meter resolution, heavily built on Sentinel-2 data and national data (LIDAR, national elevation model). Many different forest classes are included, to cater for Sweden's variety of forests. The NMD addresses different SDGs, including SDG11 (sustainable cities). There are, however, a number of open issues, including the update frequency, the evolving requirements for the Agenda 2030, the incorporation of additional data, regional and local refinements, and the integration with European products.

In the Q&A session, the presentation of good practices from Sweden, where the new Swedish national land cover and land use database is being developed based upon Copernicus data and national data, in close collaboration with the Swedish statistical institute, led to a recommendation from the participants. It stated that national success stories like this one are needed to convince the statistical community to be more receptive towards using EO-based data and therefore, a continuous dialogue with the statistical community is key.

2.1.2 Session 1 - Climate Change

Joanna Post (UNFCCC) addressed Earth Observation in support of the Paris Agreement, as it provides vital information on Essential Climate Variables (ECVs) and indicators for global warming and climate change (e.g. temperature, forest cover, sea level rise, ocean acidification). In view of this, Copernicus plays an important role in the climate system, which includes other actors such as WMO, GCOS, CEOS and GEO, and it should continue to strengthen its involvement in the UNFCCC process. The Paris Agreement agreed on a global stocktake in 2023 and 2028 as part of a periodic review looking at long-term global goals, for which Copernicus will be crucial. This is a bottom-up initiative, for which all parties need to provide information about their Nationally Determined Contributions (NDCs) in a nationally determined manner, as well as an assessment of their progress in achieving them, and it will be important to see EO can support this. At global and regional levels, EO is already supporting this through GCOS, CEOS and other initiatives.

The UNFCCC infrastructure has two important pillars, namely mitigation (to peak as fast as possible and achieve zero carbon balance) and adaptation (to enhance adaptive capacity and reduce vulnerabilities). Adaptation efforts are supported by UNFCCC through financial mechanisms. In addition, IPCC is invited to give guidelines for which Earth Observation is used to strengthen the scientific knowledge on climate, and to support communication and reporting initiatives. EO could furthermore assist parties with GHG reporting, including hotspots, cities and specific sectors.

In her presentation, **Carolin Richter (GCOS/WMO)** saw the GCOS as the glue between paperwork and practical work, putting policy into practice. GCOS is thereby assuring the availability of systemic climate observations in partnership with the World Climate Research Programme (WCRP), underlying the needs of the parties to the UNFCCC and the IPCC. According to Ms Richter, a shift took place from "observations and science informing policy", to "policy directing scientific focus", requiring stakeholders to think in a different manner. According to Ms Richter, climate observations also support the SDGs (e.g. food safety, climate change and so forth).

Efforts to tackle climate change not only focus on observations (in which remote sensing plays a part), but also cover implementation. This is where the NDCs and the global stocktake come in place, and where theories will be complemented with practical information. GCOS has come up with overarching advice on what to monitor, such as anthropogenic fluxes of GHGs, the global water cycle, urban change, monitoring for early warning systems and so forth. From there on, observations should be developed on a sustainable basis. The global climate indicators (such as mean temperature, ocean acidity, atmospheric CO_2, glacier mass balance, ocean heat content, sea level change and sea ice extent) and indicators under development can be used as a communication tool for a consistent and sustainable monitoring of the effects of climate change.

René Colditz (DG CLIMA) introduced the Paris Agreement on Climate Change, with the long-term objective to limit the temperature increase well below 2°C, and pursue the long-term objective of maintaining it below 1.5°C. The 190 NDCs are a bottom-up exercise where all countries nationally define their contributions, which is different from the practice under the Kyoto protocol. Mr Colditz furthermore gave an overview of three EU-funded climate change initiatives where EO is playing a central role. 1/ ROADLESS-FOR is a pan-tropical wall-to-wall monitoring system (1982-2017) of tropical humid forests using Landsat data, showing deforestation patterns, road network expansions, forest plantations and so forth. In order to process such huge amounts of data, the data need to be free and the necessary resources are needed to bring algorithms to the data instead of downloading these. 2/ The LULUCF regulation (2018/841) requires the use of IPCC approach 3 (geospatially explicit) to report on key categories of emissions and removals. For its implementation, Copernicus is used through pan-European data sets and the Caroline Herschel Framework Partnership Agreement (FPA). 3/ The implementation of the Montreal protocol on the phase-out of Ozone depleting substances, uses NASA-data on the ozone hole, with ongoing discussions to use Copernicus data and services.

Jean-Noël Thépaut (ECMWF) presented the portfolio of the C3S with past, present and future climate information. This includes observations, climate data and reanalyses, but also seasonal forecast data, products and climate model simulations. The C3S Climate Data Store (CDS) offers a one-stop-shop to access climate data, with the tools to use the data, information on sectoral impacts and so forth. C3S is increasingly contributing to the activities from EEA, GCOS and WMO, but also to the monitoring of UNFCCC SDGs, for which the C3S data and services have a relevance beyond climate change (e.g. also food security, health risks, biodiversity and so forth). Examples include C3S data and services to monitor suitability for vector-borne diseases or to monitor urban heat islands (for SDG 3 – health and well-being).

Christiana Photiadou (Swedish Meteorological and Hydrological Institute) provided a user perspective with regard to the Copernicus C3S, concerning the importance of knowledge purveyors such as agencies operating in water management as an interface between climate services and climate adaptation efforts. This was demonstrated with the Climate Impact Indicators' hydrological forecasts, which will soon migrate to the C3S site. In its production chain, SMHI includes users' feedback to see which indicators they need and what variables they require for decision-making processes, with a significant number of users from all over the globe. These do not only relate to water management, but a number of different sectors through the hydrological component. Copernicus data and information are provided for clean and sanitized water (e.g. for breweries), health indicators, urban management and natural disaster resilience.

In the **Q&A-session**, participants raised the potential of combining climate change adaptation and mitigation with disaster risk reduction, such as biodiversity corridors which provide both at once since the soil acts as a carbon sink while it enforces resilience against disasters. In addition, a member from the audience underlined the need to connect data from e.g. DG ECHO and the Copernicus Emergency Management Service for the EU's info index of country risk profiles.

2.1.3 Session 2 – Marine

Emma Heslop (IOC/UNESCO) from the Intergovernmental Oceanographic Commission and UNESCO introduced the Global Ocean Observing System (GOOS), which aims to lead the ocean observing community and to create partnerships for an integrated system. Its products and activities range from observations to data management, analyses and models, information services (such as Tsunami Early Warning Systems) and applications. One million observations are taken per day, for which in-situ elements are a main component of the observing system. GOOS has a partnership with CMEMS where observations are a foundation for the quality of the service. In addition, GOOS is working closely with GCOS, as their ECVs are closely integrated. Under the Global Ocean Acidification Observing Network (GOA-ON), which includes 506 scientists from 83 countries, GOOS aims to document the status and progress of ocean acidification and understand its impacts on diverse marine ecosystems.

Zoi Konstantinou (DG MARE) introduced the different international assessment tools which are in place, such as the UN 2030 Agenda, the UN CBD Aichi Biodiversity Targets and International Ocean Governance. Ocean Observations are dealing with a number of challenges, such as the multi-dimensional nature of the marine environment (for which information is needed of the surface, the water column and sea-bed); the multi-use of coastal and marine space; the fact that data collection can be more complicated, time-consuming and expensive compared to Earth Observation; the fact that a different resolution is required depending on the area and intensity of human activities; and the fact that the majority of marine areas falls into International Agreements' territory. The European Commission (DG MARE) has a number of Ocean Observation and Info Systems (OOIS), including Copernicus, SeaDataNet and EMODnet, which are contributing or could contribute to SDG 14 (e.g. on coastal eutrophication, floating plastic density, average pH, and so forth). In addition, these systems could contribute to other SDGs and International Agreements, including SDG 7 (energy for all), 8 (economic growth) and 13 (climate change).

Karina Von Schuckmann (Mercator Ocean) provided a perspective on the SDGs from the CMEMS. Ms Von Schuckmann advocated for the use of the wedding cake presentation for SDGs, moving away from the current sectorial approach where social, economic and ecological development are seen as separate parts, with a transition to a world logic where economy serves society which evolves within the safe operating space (biosphere) of the planet. This is where the marine domain comes in place, as the world ocean plays a key role in the Earth system, ranging from heat uptake and storage, to carbon uptake and storage, ocean currents, O_2 and H_2O-reservoirs, sea ice, food security and so forth. This is recognised at the highest levels, including at the G7, the IPCC, GEO, EEA, the EU Arctic Policy and much more. In terms of SDGs, there are two prominent roles of environmental information, namely to 1/ monitor the progress and implementation of SDGs and 2/ deliver information about the state of the environment. To do so, CMEMS has two tools: 1/ the Copernicus Marine Ocean State Report and 2/ the Copernicus Marine Ocean Monitoring Indicators (ocean heat content, sea level and sea ice).

Lorelei Picourt presented the **Ocean and Climate Platform**, which comprises an international network of 70 organisations, public institutions and NGOs. The network was created in 2014, ahead of COP21, as oceans were at that point not included in climate negotiations. The Ocean and Climate Platform strives for a healthy ocean for a protected climate, through a dynamic network of multi-stakeholders, scientific mediation and dissemination of knowledge, and policy recommendations and international cooperation. The project holds an observer status at UNFCCC conferences, and is co-organising an annual ocean actions day, promoting Ocean Monitoring Indicators (OMIs) to ensure an informed decision-making process.

Siegfried Schmuck (SCIAENA) introduced SCIAENA, a Portuguese NGO aiming to promote the improvement of the marine environment by encouraging the sustainability of fisheries and other forms of use, and minimising the impacts of pollution through knowledge, education, communication and political

intervention. According to Mr Schmuck, Copernicus can contribute to the management of fish stocks, who will migrate due to climate change, by providing accurate time series of the ocean surface water temperature and salinity, which can inform on future fishing opportunities. In addition, Copernicus could contribute to the implementation of the EU directive on single-use plastics, which foresees extended producer responsibility to cover clean-up costs, with patterns of currents and storms to predict sources and sinks of marine litter, to facilitate such clean ups. For the Aichi-convention on biological diversity, Copernicus data and information showing the intensity of fishing levels in Marine Protected Areas (MPAs) would help demonstrate to regulators that laws and enforcement are needed to stop intensive fishing in MPAs, and in particular the illegal, unreported and unregulated (IUU) fishing which depletes fish stocks, destroys marine habitats, distorts competition and weakens coastal communities. Ms Schmuck valued the access to the environmental data by CMEMS, CAMS and C3s, but regretted that a CMEMS service of human activity (for fisheries control or marine pollution monitoring) is not yet available to the public.

In the **Q&A-session**, one participant enquired about the possibility for very high-resolution data. According to Ms Heslop (GOOS), this is being thought of, and it should be done in a cooperation between the satellite community, ocean community and modelling community. According to Ms Von Schuckmann, CMEMS should take next steps into coastal areas, which is still one of the big remaining challenges.

Several attendees pointed out that Copernicus and CMEMS provide great information through the Ocean State Report. In doing so, Copernicus is useful for some SDG indicators and even beyond. The participants agreed that the wider, problem-focused data are important to include.

In response to a question about the inclusion of chemical parameters for Copernicus modelling, Ms Konstantinou stated that this already exists at EU-level, for which data are collected. There is a collaboration with Copernicus to validate the models; however, not all data are available and in-situ data are often very expensive.

2.1.4 Session 3 - Land and Water

Stuart Crane (United Nations Environment Programme) elaborated on the value of Earth Observation to monitor progress towards SDG 6.6 'Protect and restore water-related ecosystems. These include vegetated wetlands, rivers, lakes, reservoirs and groundwater, thereby horizontally touching upon other SDGs such as 15 'life on land', 6 'clean water and sanitation' and 13 'climate action'. According to Mr Crane, most countries have little to no information on the extent of their water-related ecosystems. Only a few of these countries provided data, which UNEP received from DG JRC. Based on this, UNEP and its partners created 188 country data sets in 2017 on the spatial extent of water, which were shared with national statistical offices for validation. As a result, indicator 6.6.1 'change in extent of water-related ecosystems over time' has been approved by the inter-agency expert group as tier-1 because of the Earth Observation data. Where there was a lack of in-situ data, the Earth Observation community stepped in and helped out. To meet country requirements over the long term, time series data are needed. In addition, UNEP would like to see data on the spatial extent of open water at basin level (not national), the delineation of reservoirs, water dynamics and the quality of reservoirs, the water quality of lakes and the mapping of vegetated wetlands.

Jorge Rodriguez Romero (DG ENV) introduced the DG's responsibilities on international forest policy, wildlife trafficking and other multilateral environment agreements. In doing so, DG ENV wants to make sure that the law is respected and intends to improve the existing policies considering the implementation gap in the EU, which is costing society approximately 50 billion EUR every year. Copernicus data and information could not only serve as a definite proof of illegal activities, but could also be a supporting tool for early warnings that enforcement authorities can use for further investigation. This can be limited to some specifically defined areas of land where there is a risk, such as specific national forests. An important element here is the

monitoring frequency to ensure that an alert is given within a reasonable time frame after the illegal activity. This is where the automatic processing of information can make a big difference. In this way, Earth Observation can support several policies, for instance on illegal logging (which can be provided on a global scale to EU-partners Africa, Southeast Asia and Latin America), or on the trafficking of endangered species.

Chris Steenmans (EEA) presented the EEA's indicators based on the Copernicus Land Monitoring Service (CLMS) noticing an increased use of Copernicus CLMS products to support sustainable development. Examples include land take change (where land is cut off from its natural function), which was provided to Eurostat which is responsible for reporting SDGs in an EU-context. This parameter however did not fit the requirements of statistical offices, where one of the criteria is the update frequency. The CLMS offer was modified to include the imperviousness change rate (which is what decision-makers wanted) as part of the next reporting. Other examples include land cover and land use, the urban atlas, land recycling and densification, or flood risk mapping for climate change impact and adaptation. A product which will monitor CO_2 from land use in the context of Land Use, Land-Use Change and Forestry (LULUCF) is currently under development. According to Mr Steenmans, when a series of products is fine-tuned to an end product, one should first look at what is required for carbon accounting and then see what product is needed as part of the portfolio.

Greet Janssens-Maenhout (DG JRC) presented the Copernicus Land Monitoring Service – Global component (CLMS), and its relevance for SDGs including some DG JRC developments. With the use of Earth Observation data, all countries are unlocked. This is no longer just to check the status of a country, but to monitor the progress towards a common sustainable development goal. The measurements are combined with reporting requirements and are verified (for which some models are needed). By combining data sets, one can come to something that is robust and that can be agreed upon by many countries over a longer timeframe. It is thereby important to build synergies and to collaborate, taking on board the users and producers of these data. The portfolio of the global land component of Copernicus contains various products supporting the implementation and the monitoring of international conventions and agreements. DG JRC has also developed several products and applications answering to SDG indicators monitoring requirements like the Global Surface Water Explorer or the Land Productivity Dynamics included into the World Atlas of Desertification.

Carsten Brockmann (Brockmann Consult) offered a perspective from a service providing company. Brockmann Consult offers relevant expertise for a number of environmental agreements, covering biodiversity, climate change, transboundary water and air pollution and maritime and river protection. Examples of its products include the Global Mosaic for CLMS, water quality under the Copernicus Global Land component, CyanoAlert (offering space-based cyanobacteria information and services) or the Globwetland-Africa Toolbox, providing workflows for processing wetland products and inland water quality products. According to Mr Brockmann, the Copernicus programme is a critical factor for its success, due to its global coverage with short repetition times, the combination of different technologies (SAR, optical HR, optical MR), the Copernicus Services which provide higher level information and the long-term sustainability, which is an essential aspect when talking to environmental monitoring stakeholders.

Marc Paganini (ESA) considered data and evidence as the foundation of development policies and effective programme implementation, and saw an opportunity in the advent of steady satellite data streams to be mobilised for wider benefits, such as a contribution to the SDGs. There are, however, several obstacles to the use of EO in the global SDG agendas, such as restrictive data access policies, not enough 'fit for purpose' products, a lack of standardisation of EO data processing methodologies, an insufficient frequency of observations to track changes at appropriate scales, the need for continuity and long-term EO-programmes and so forth. An international collaboration to scale up EO innovation could address these obstacles, with global datasets, guidance on good practices, capacity building, knowledge sharing and EO enabling infrastructure tools and platforms. This collaboration takes place in e.g. the GEO initiative on SDGs, the CEOS

ad-hoc team on SDGs, at UN-level (UN-GGIM) or the Inter-Agency Expert Group on SDG Indicators (IAEG-SDGs). Therefore, Mr Paganini saw a need to infiltrate into these agencies to see how EO-data can be accepted by end communities. As a conclusion, Mr Paganini underlined the importance of free and open data policies with long-term continuity and frequent revisiting, adding that advances in IT will allow the processing of data at affordable prices. Furthermore, EO-data, combined with socio-economic and other information, allows an improved understanding of developmental and environmental patterns.

In the **Q&A-session**, the audience discussed the need to reach out to (statistical) agencies, as it is hard to convince these institutions about the use of a certain method, which is required for SDG monitoring. Another discussion dealt with the question on comparable reporting between countries: the UNEP representative, explained that an inter-agencies expert group, which is made up out of national statistical institutes, decides which methodologies are approved. This must generate comparable reporting between countries. Countries are reporting into a UN system (globally comparable) but that does not prevent a country from tweaking the reporting to make it nationally/sub-nationally more relevant. One participant formulated the recommendation for countries to include Copernicus in the national strategies to support the SDGs.

Another discussion dealt with the Copernicus full, free and open data and information policy. Different stakeholders (SME, UNEP, ESA) confirmed that global agendas are calling for cost-effective solutions that can help countries worldwide addressing efficiently their development challenges. For this, the Copernicus full, free and open data and information helps to reduce the costs of monitoring the progress towards the SDGs.

2.1.5 Session 4 – Atmosphere

Oksana Tarasova (GAW/WMO) presented the Global Atmosphere Watch Programme (GAW), which provides international leadership in research and capacity development in atmospheric composition observations and analysis through long-term observations of the chemical composition and related physical characteristics of the atmosphere, quality assurance and quality control, and delivering integrated products and services related to the atmospheric composition of relevance to its users. In doing so, GAW provides evidence for policy-makers and affects communities and services (forecasting) for the prevention of impacts. Internationally, GAW supports several conventions and agreements, including the Convention on Long-Range Transboundary Air Pollution; the SDGs (SDG 3, SDG 11); the WHO Global Conference on Air Pollution and Health; the UNFCCC including the Kyoto Protocol and the Paris Agreement; UV Forecasts; the Vienna Convention for the Protection of the Ozone Layer; the Convention on Biological Diversity; the Convention to Combat Desertification and several others. In its activities, GAW is cooperating with CAMS for the development of systems and models.

Vincent-Henri Peuch (ECMWF) argued that the atmospheric composition is relevant for several SDGs, exemplified by examples such as urban smog (SDG 11), regional smog (SDG 3), climate action (SDG 13), biogeochemical cycles (SDG 15), acid rain and so forth. In addition, Mr Peuch offered insight in four actual Copernicus Atmosphere Monitoring Service use cases on air quality and health at a global scale (with WMO, WHO and UNEP); the monitoring of the ozone layer (with DG CLIMA and WMO), the drivers of European air quality (with DG ENV, DG JRC and EEA) and on inverse modelling of surface fluxes of the main greenhouse gases (WMO and IPCC).

Aidan Farrow (Greenpeace Science Unit) presented three case studies where Greenpeace used Earth Observation. In the Winter of 2017, the Chinese government wanted to cut winter levels of PM by 15% in Beijing by closing industrial plants. NASA OMI data were used to measure the success, with historic drops in SO_2 and NO_2. In its 2016 'Out of Sight' report, Greenpeace used NASA's OMI instrument to reveal sources and pollutant concentration trends in India at a time of increasing coal use in power generation, thereby shifting the debate which was at that time mainly focussed on visible pollutant sources in urban areas. More recently,

Greenpeace used the first three months of Sentinel-5P Tropomi-data to analyse hotspots with the greatest NO_2 columns. Interactive maps and animations showed the 50 largest hotspots globally by sector, reaching press coverage on a global scale.

In the **Q&A-session**, participants stressed the importance to provide feedback and to communicate to users and stakeholders. In this sense, also Eurostat should be included. In terms of communication, attendees saw a potential to include more information on the SDGs and Agenda 2030 on the Copernicus webpage.

Another discussion confirmed the importance – especially for NGOs, of evidence-based campaigning.

2.2 Conclusions

This Copernicus industry workshop was an important stocktaking of the importance on how EO and geospatial data can contribute to the monitoring of the SDGs, international conventions and agreements.

The success of the workshop is thanks to the engagement of the different responsible international bodies (UN bodies, WMO and so forth) but as well as to the Commission´s own DGs, the different Copernicus entrusted entities (e.g. Copernicus services, ESA), NGOs, industry, and national authorities. These different stakeholders have shown through the presentations, interactions and discussions the important value that EO-based data and information and more specific Copernicus data and Copernicus services information products, bring in the assessment and monitoring of the sustainable development agenda and international conventions. They encouraged Copernicus and its services to continue and even to improve its support to SDG and convention monitoring.

Copernicus data and services' information cover or can potentially cover a wide variety of applications and indicators for the monitoring of SDGs, International Agreements and conventions, but also for **communication and literacy** purposes and for providing evidence-based **information to** decision/policy makers. Such applications/indicators range from Climate Action (mitigation and adaptation efforts; ocean acidification, sea surface temperature, sea level, glaciers, GHGs such as CO_2 and NO_2, vessel emissions monitoring), to life on land (environmental degradation, compliance with environmental policies, air quality, biogeochemical cycles), life below water (addressing illegal fishing, plastic density), good health and well-being (mapping of susceptibility for vector-borne diseases, urban heat island mapping), zero hunger (land use and land cover, soil moisture) or clean water and sanitation (algal blooms, water quality, cyanobacteria monitoring).

In terms of **user requirements** of global stakeholders **for SDGs, International Agreements and conventions**, the following needs were repeatedly expressed:

1. The long-term **sustainability and continuity** of Earth Observation programmes and infrastructures, and the availability of a **time series of Earth Observation data over the long term** is crucial to monitor indicators for SDGs or other International Agreements over time

2. The **revisit time** of EO data is crucial to ensure its relevance for several applications, for example IUU fishing or wildlife monitoring.

3. Copernicus' **full, free and open data and information policy in combination with collaborative big data platforms (DIAS[1])** is indispensable to enable the use of large data volumes for the monitoring of SDG indicators;

In recent years, a **transition** has taken place: from "observations and science informing policy", to "policy directing scientific focus", requiring stakeholders to think in a different manner. This is exemplified by the development of specific datasets to monitor SDG indicators as required, or the necessity to have data accepted by the inter-agency expert group before they can be used to monitor SDGs.

One can identify a growing attention to the importance and prominence of data-related aspects for Earth Observation and Monitoring, and its contribution to the monitoring of SDG indicators. Firstly, **synergies using different data sources (EO, in situ and other data sources)**, collected through i.e. **different remote sensing technologies (optical, LIDAR, SAR, multispectral)** are increasingly important. For example, for validation and calibration purposes and/or to guarantee provision of robust, evidence-based data and information that can be accepted as (basis for) common indicators by a large set of countries. Secondly, there is need for an increasing involvement of national, European **statistical offices**, who often play a gatekeeping role to determine the usability of certain datasets for SDG indicator monitoring. National success stories could be used to convince the statistical community to start using Earth Observation data as an additional/complementary data-source. Thirdly, the existing or expected use of **emerging data processing technologies**, such as artificial intelligence, big data analytics or enhanced automated processing algorithms, could provide a more accessible and cost-effective capacity for decision-makers to monitor the SDG indicators or the International Agreements and conventions.

Copernicus and its contribution to SDGs, International Agreements and conventions, has a **strong international dimension**. Whereas this was already foreseen in the original regulation, it has been reinforced in the latest Space Policy and in the Proposed Regulation for a Union Space Programme. In recent years, Earth Observation has shifted from a tool to observe, to an international aid mechanism to monitor common global targets such as the SDGs. This international dimension can be translated into e.g. partnerships with different international institutions and agencies, including UNEP, UNFCCC, WMO, UNESCO, GEOSS, CEOS or GEO).

Finally, the Copernicus full, free and open data and information helps to reduce the costs of monitoring the progress towards the SDGs.

[1] The DIAS (Copernicus Data and Information Access Services) facilitates data processing as well as data analytics and is based on the concept "bringing the users to the data and information".

3 ANNEX I: THE SUSTAINABLE DEVELOPMENT GOALS

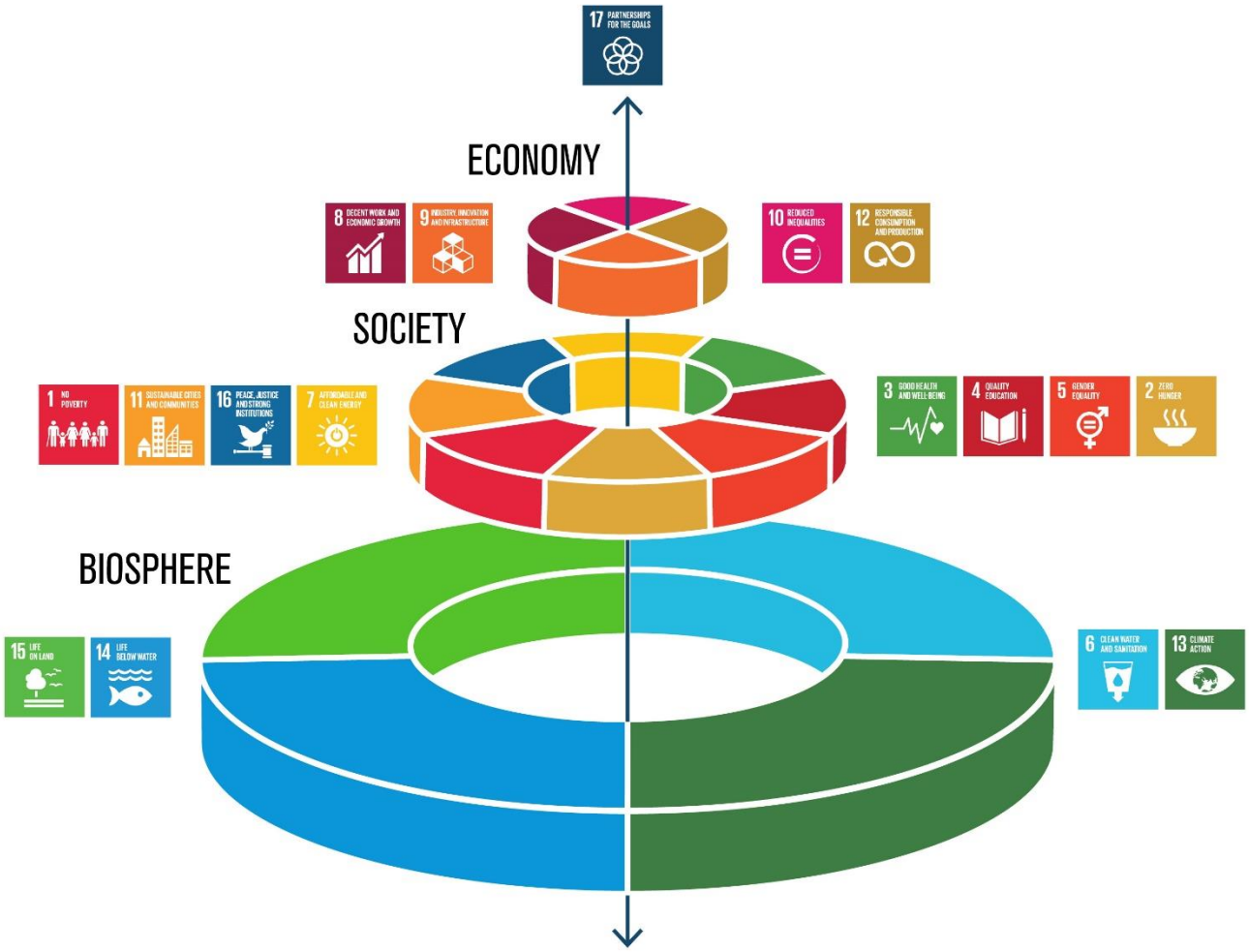

Figure 1: Sustainable Development Goals[2]

[2] Retrieved from: https://www.stockholmresilience.org/images/18.36c25848153d54bdba33ec9b/1465905797608/sdgs-food-azote.jpg

4 ANNEX II: WORKSHOP AGENDA

09:00-09:30 **Registration and welcome**

09:30-09:35 **Welcome and opening**

- **Elisabeth Hamdouch**, Deputy Head of Unit, Copernicus, DG GROW, European Commission

09.35-10.10 **Setting the scene: Copernicus EO data and information in support of the SDGs**

Moderator: Catharina Bamps, DG GROW

- DG JRC/DG GROW: **Mark Dowell**
- Swedish Agency for Marine Water Management: **Thomas Klein** - *"A statistical geospatial framework for sustainable development"*

Q&A

10:10-11:20 **SESSION 1: Climate Change**

Moderators: Mark Dowell, DG JRC and Bernard Pinty, DG GROW

- UNFCCC Sec: **Joanna Post** – *"Earth Observation in support of the Paris Agreement"*
- WMO/GCOS: **Carolin Richter** – *"Earth Observation – How to support the Paris Agreement Goals?"*
- DG CLIMA: **Rene Colditz**
- C3S/ECMWF: **Jean Noel Thepaut**
- SMHI: **Christiana Photiadou** – *"Global Users in the Copernicus Climate Change Service"*

Q&A

11:20-11:35 **Coffee break**

11:35-12:50 **SESSION 2: Marine**

Moderators : Mark Dowell, DG JRC and DG GROW

- UNESCO: **Emma Heslop** – *"Ocean Observations and Information in support of SDGs, assessment frameworks and policy"*
- DG MARE: **Zoi Konstantinou** – *"Ocean Observation and DG MARE – Towards a sustainable global vision"*
- CMEMS/Mercator Ocean: **Karina Von Schuckmann**
- Ocean and Climate Platform: **Loreley Picourt** – *"A healthy ocean of a protected climate: how to move from science to policy?"*
- SCIAENA: **Siegfried Schmuck** – *"Marine Conservation and Copernicus"*

Q&A

12:50-14:00 **Lunch**

14:00-15:35 **SESSION 3: Land and Inland Waters**

Moderators: Mark Dowell, DG JRC and Michel Massart, DG GROW

- UNEP: **Stuart Crane** – *"The value of Earth Observation in helping countries monitor progress towards SDG target 6.6: 'protect and restore water-related ecosystems'"*
- DG ENV: **Jorge Rodriguez Romero** – *"DG operational policy information requirements"*
- CLMS/EEA: **Chris Steenmans** – *"EEA indicators based on Copernicus Land Monitoring Service – CLMS"*
- CLMS/DG JRC: **Greet Maenhout** – *"Global indicators for SDGs with the Copernicus Global Land Monitoring product"*
- Brockmann Consult: **Carsten Brockmann**
- ESA: **Marc Paganini**

Q&A

15:35-16:00 **Coffee break**

16:00-17:05 **SESSION 4: Atmosphere**

Moderators: Mark Dowell, DG JRC and Catharina Bamps, DG GROW

- WMO/GAW: **Oksana Tarasova** – *"Role of WMO in support of environmental conventions"*
- DG ENV: **Zlatko Kregar** – *"An update on Clean Air Policy in the EU"*
- CAMS/ECMWF: **Vincent-Henri Peuch**
- Greenpeace Science Unit: **Aidan Farrow** – *"Using Remote Sensing to reveal air pollution sources and trends"*

Q&A

17:05-17:30 **Wrap up and conclusions**