EO4SDG:

EARTH OBSERVATIONS
in Service of the 2030 Agenda for
Sustainable Development

**Strategic
Implementation
Plan**
2020-2024

PREFACE

Well-being, economic growth, hunger, sanitation, poverty, energy, disease, fresh water, disasters, air quality, biodiversity, deforestation, hygiene, urbanization, food security, environmental challenges …. These all happen somewhere in space and through time.

A significant opportunity exists to address these challenges by bringing together data and applying information about people and places into national monitoring and evaluation systems to improve human and environmental conditions.

In September 2015, the United Nations General Assembly endorsed *Transforming Our World: the 2030 Agenda for Sustainable Development*, a global development agenda for all countries and stakeholders to use as a blueprint for progress on economic, social and environmental sustainability.

Seventeen Sustainable Development Goals (SDGs) and associated Targets and Indicators anchor the *2030 Agenda*, which specifically calls for new data acquisition and exploitation of a wide range of data sources to support implementation. Article 76 states, "We will promote transparent and accountable scaling-up of appropriate public-private cooperation to exploit the contribution to be made by a wide range of data, *including Earth observation and geo-spatial information*, while ensuring national ownership in supporting and tracking progress."

The Group on Earth Observations launched the *Earth Observations for the Sustainable Development Goals (EO4SDG)* initiative to contribute to the *2030 Agenda* and realize the potential that Earth observations and geospatial information offer to the SDGs and the normative benefits they represent.

Three years into the implementation of the 2030 Agenda, reliance on geospatial information and Earth observations has been gaining momentum as countries and relevant stakeholders apply information about people and places into monitoring and evaluation systems to improve human and environmental conditions and monitor progress towards achieving the SDGs.

There are now more targeted discussions, and examples, of fit-for-purpose datasets, tools, and methodologies that advance integration of Earth observations in support of sustainable development applications. In addition, capacity building and resource mobilization efforts have been focusing on strengthening the ability of countries to integrate a range of new data sources into national statistical systems, and raising resources to address the data needs for the full implementation of the 2030 Agenda.

This document provides un update to the strategic implementation plan for EO4SDG, guiding GEO's activities for 2020-2024. We plan to continue demonstrating practical and innovative uses of Earth observations, building capacity, promoting data access, and supporting country and stakeholder adoption, especially in hopes of enabling the use of Earth observations in broader ways to inform decisions and actions. We also plan to continue providing technical and other guidance for SDG relevant projects developed under other GEO activities, serving a coordination role to GEO's overall service to the SDGs.

We welcome your involvement and contributions in the service of the GEO community and Earth observations to the societal benefits achievable through the Sustainable Development Goals.

Cordially,

The EO4SDG Team

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EXEXUTIVE SUMMARY

Earth Observations for Sustainable Development Goals (EO4SDG) Initiative

The primary contact for the Initiative is Dr. Argyro Kavvada (United States [NASA]), Argyro.Kavvada@nasa.gov.

The 2030 Agenda for Sustainable Development calls for new data acquisition and integration approaches to improve the quality, coverage, and availability of data to support the implementation of the development agenda at all levels. Article 76 states, "We will promote transparent and accountable scaling-up of appropriate public private cooperation to exploit the contribution to be made by a wide range of data, including Earth observation and geospatial information, while ensuring national ownership in supporting and tracking progress." This presents a unique opportunity for Earth observations and geospatial information to be integrated into national information systems and monitoring frameworks, as well as real-world applications that can reduce and mitigate environmental risk and disasters, creating more sustainable and resilient societies.

To support this call with concerted action, the GEO Mexico City Declaration from the 2015 GEO Ministerial affirmed that "GEO and its Earth observations and information will support the implementation of, inter alia, the 2030 Global Goals for Sustainable Development..." and called on GEO to "...launch a GEO initiative to leverage Earth observations to support the implementation, monitoring and evaluation of the 2030 Global Goals for Sustainable Development, building on the recent success of GEO's engagement with the United Nations on this issue." Furthermore, at the GEO-XII Plenary meeting, GEO enacted the GEO Engagement Priorities, approving three policy initiatives as initial priorities for GEO, including the 2030 Agenda for Sustainable Development, the Paris Agreement on climate and the Sendai Framework for Disaster Risk Reduction.

The Earth Observations for Sustainable Development Goals (EO4SDG) Initiative organizes and realizes the potential of Earth observations and geospatial information to advance the 2030 Agenda and enable societal benefits through achievement of the SDG. EO4SDG works with GEO Members, Participating Organizations and other GEO Initiatives and Flagships to integrate Earth Observations in local, national and global SDG processes. Beyond broadening interest and awareness of Earth observation support to the SDG, and increasing skills and capabilities in countries to use Earth observations for the SDG and their broader benefits, the Initiative focuses on developing examples and use cases where countries have adopted and integrated Earth observations into SDG processes, especially in hopes of encouraging more countries and UN agencies involved in the SDG process to follow suit.

In addition, EO4SDG, in partnership with CEOS, engages in efforts that advance the provision, access, discoverability, and applicability of Earth observations and geospatial information for use with the SDG. This element draws on GEO's efforts to characterize user needs, especially in the collection of information from SDG user organizations, to help refine approaches to enable greater use of Earth observations for the SDG. EO4SDG also serves to "federate" all of GEO's Community Activities, Initiatives and Flagships that include an SDG element to increase SDG-related knowledge sharing across the GEO Work Programme. The Initiative provides technical and other guidance for projects developed under other GEO activities, serving a coordination role to GEO's overall service to the SDG.

The prime users of EO4SDG are National Statistical Offices (NSOs), National Mapping Agencies, line ministries, international statistical agencies, UN custodian agencies, and other major groups and stakeholders. The Initiative promotes the emergence and scaling-up of joint efforts and collaboration between these users and the geospatial and Earth observation communities to demonstrate effective uses of Earth observation data in complementing traditional data systems such as census data, administrative data, household survey data, and vital statistics, to help achieve the SDG.

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EO4SDG, in collaboration with thematic GEO Work Programme elements, works closely with custodian agencies responsible for specific indicators relevant to their thematic expertise and mandate – such as the UN Environment Programme, the UN Convention to Combat Desertification (UNCCD), and the UN Habitat – on SDG indicator method development, testing, refinement, adoption, and widespread, sustained use. These efforts have led to proposals within the UN system to elevate the readiness status of global methodologies related to fresh water, terrestrial ecosystems, and sustainable urbanization, with Earth observations integrated as notable inputs. This resulted in the precedent setting elevation of four indicator methodologies[1] to a higher classification tier, with GEO having been recognized as a key contributor in this process. UN Environment now uses global Earth observation products for official SDG reporting and for assessing indicator 6.6.1 (freshwater ecosystems) at global, regional and national levels. In addition, UN Environment works with EO4SDG and other activities of the GEO Work Programme to assist countries in using Earth observation data to not only measure and report on relevant indicators, but to also take action toward protecting water-related ecosystems.

In addition, EO4SDG works with the United Nations (UN) Inter-Agency Expert Group on Sustainable Development Goals (IAEG-SDG)[2] Working Group on Geospatial Information (WGGI), a working group responsible for reviewing the Global Indicator Framework through a "geographic location lens" and identifying how geospatial information, including Earth observations, can contribute toward addressing the SDG. In 2019, the WGGI, in close collaboration with EO4SDG and CEOS, established a Task Stream on *Earth observations for SDG indicators,* whose principle objectives include the provision of guidelines regarding the minimum standards required for geospatial data to be considered as official data in the generation of statistics and the SDG, and the role of NSOs in the uptake of Earth observations for SDG indicators. This task stream aims to also identify challenges in using geospatial information with the SDG, and to provide recommendations for addressing these challenges. EO4SDG will make available a compendium on Earth observation contributions to SDG indicators, with indicator factsheets and a companion policy brief (under review), through its website (http://eo4sdg.org) and as a contribution to this task stream.

Overall, EO4SDG enables countries and organizations to leverage Earth observations to support the implementation, planning, measuring, monitoring, reporting, and evaluation of the SDG and their normative societal benefits via pilot projects for method development, distribution, and adoption; a portfolio of capacity development activities to support institutions and individuals in the development and implementation of methods; and other efforts to advance the provision, access, and applicability of Earth observations for use with the SDG (e.g., GEO survey on data characteristics, usability, and user needs; developing a framework for moving from EO observable themes to information products for specific indicators to decisions). EO4SDG plans to package reproducible EO integrated methodologies and guidelines, in partnership with its end-users, encompassing all relevant EO datasets, available tools and platforms, training material, as well as use cases and national experiences per SDG target and indicator supported by Earth observations. These comprehensive methodologies will be presented in an openly accessible way and be made available via the EO4SDG website (http://eo4sdg.org). These can also be linked to the GEO Knowledge Hub, and will be accompanied by capacity development efforts through functional tools and trainings.

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[1] These include indicators 6.3.2 (ambient water quality), 6.6.1 (spatial extent of water-related ecosystems), 11.7.1 (average share of the built-up area of cities that is open space for public use for all) and 15.3.1 (proportion of degraded land per total land). Additional progress has been made towards scaling the use of Earth observations in support of indicator 11.3.1 (land consumption per population growth).

[2] The UN Inter-Agency Expert Group on Sustainable Development Goals (IAEG-SDG), established in 2015 by the UN Statistical Commission (UNSC), is responsible for developing and implementing the Global Indicator Framework for the Goals and Targets of the 2030 Agenda.

VISION   Countries, stakeholders, and the global community desire additional Earth observations and geospatial information to continue progress on improved social, economic, and environmental sustainability.

By 2030, the Group on Earth Observations envisions a world in which uses of Earth observations and geospatial information to support progress on the Sustainable Development Goals are valuable, routine and customary. In the first five years of the *Agenda*, GEO envisions that the foundation has been laid for governments and organizations to capitalize fully on the benefits Earth observations provide to monitor, plan, and report on the SDGs through 2030.

Realizing this vision implies that: the global community is aware of effective ways to use Earth observations and geospatial information relative to the SDGs; countries and stakeholders have the skills and capabilities necessary to apply the data and information; the global community employs smart practices and solutions on uses of Earth observations in planning, tracking, and reporting; Earth observations provide real, value-added benefits and are recognized for their contributions to support positive social, economic, and environmental impacts; and there is demonstrated progress on the Goals and broad desire for more.

Achieving this vision also implies that countries and stakeholders have timely access to needed data and information, and they can seamlessly integrate them where applicable – that data is openly available, especially where achieving SDGs requires multi-national or regional approaches and coordination. There are on-going collaborations among Earth observation providers, stakeholders, and countries, especially with national statistical offices. Additionally, there are open lines of dialogue to consider and appropriately support needs for data, training, method testing, and capacity building. Countries and stakeholders recognize the value of the data and information for the SDGs, and they want additional data and enhanced information for the SDGs and for broader activities, planning, and decisions. Overall, they envision and are motivated to pursue new opportunities to enable societal benefits.

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PURPOSE   Organize and realize the potential of Earth observations and geospatial information to advance the *2030 Agenda* and enable societal benefits through achievement of the Sustainable Development Goals.

EO4SDG serves a fundamental role to advance global knowledge about effective ways that Earth observations and geospatial information can support the SDGs. The Initiative seeks to advance the benefits of the SDGs through sustained, effective use of Earth observations. And, these uses can lead to greater awareness of, and interest in, Earth observations to enable even greater societal benefits.

The 2030 Agenda specifically calls for new data acquisition and exploitation of a wide range of data sources to support comprehensive review and implementation processes at global, national, and sub-national levels. Article 76 states, "We will promote transparent and accountable scaling-up of appropriate public private cooperation to exploit the contribution to be made by a wide range of data, including Earth observation and geospatial information, while ensuring national ownership in supporting and tracking progress." This presents a unique opportunity for Earth observations and geospatial information to be integrated into national information systems and monitoring frameworks, as well as real-world applications that can reduce and mitigate environmental risk and disasters, creating more secure, sustainable, and resilient societies.

EO4SDG involves technical, organizational and programmatic components. Collectively, these items meld in the projects, data, outreach and engagement, and capacity development related to how Earth observations can support the *2030 Agenda*.

When countries and stakeholders use Earth observations on a sustained basis for their SDG activities, the EO4SDG initiative will be successful. And, if their SDG-related use of Earth observations leads to broader uses or stimulates new and improved collections of Earth observations, this Initiative will have truly helped GEO fulfill its overall purpose and vision.

INITIATIVE GOALS

EO4SDG has three goals and associated objectives to realize the vision and serve the purpose described above. The goals describe overarching, desired outcomes, and the objectives articulate specific, measurable results.

    GOAL I   Demonstrate how Earth observations, geospatial information, and socio-economic and other data contribute in novel and practical ways to support sustainable development efforts and the SDG.

    GOAL II   Increase skills and capabilities in uses of Earth observations for SDG activities and their broader benefits.

    GOAL III   Broaden interest, awareness, and understanding of Earth observations support to the SDGs and contributions to social, environmental, and economic benefits.

Goal I focuses strongly on the development and uptake of quality methods using Earth observations for use with the SDG, associated Targets, and the global Indicator framework. Applied research, feasibility testing, development, and operationalization of innovative and practical methods are part of this goal, including assessments across users and regions as well as of data availability. User engagement and co-development of methods and testing are important and integral to successful development and uptake.

The prime users of EO4SDG are National Statistical Offices (NSOs), National Mapping Agencies, line ministries, international statistical agencies, and UN entities. EO4SDG promotes the emergence and scaling-up of joint efforts and collaborations between these users and the Earth observation/ Geospatial Information (EO/GI) community to demonstrate the effective uses of EO/GI data in complementing traditional data systems, such as census data, administrative data, household survey data, and vital statistics, to achieve the SDGs. In addition to addressing timely access to needed data and information, the goal includes efforts to integrate Earth observations and geospatial information into internationally approved guidelines, as well as national development and monitoring frameworks for the SDGs. Partnerships with organizations and communities to support broad use of effective methods and solutions is implicit, and this goal entails significant work to enable the adoption of these methods.

EO4SDG has established priority areas for the development of methods applying Earth observations to the SDGs. In addition, the UN IAEG-SDGs WGGI has developed a shortlist of 24 indicators where geospatial information and Earth observations, together with statistical data, can contribute directly (or indirectly) to the production of these indicators. These are considered priority indicators for GEO, particularly those that are categorized as Tier III—i.e., indicators with no established methodology or standards, but for which methodology and standards are being (or will be) developed or tested, and those that are categorized as Tier II — i.e., indicators with an established methodology but where data are not regularly produced by countries.

The following are objectives under Goal I:

By 2024, develop and share 30 good practice examples with GEO members, partners and the wider international community to drive impact.
Over 30 countries have specific examples on how they have applied EO in assessing, and reporting on, SDG indicators.

Propose that IAEG accept ten (or more) methods by 2024, contributing to the advancement of 15 indicators to a higher tier (Tier II/ I).
The Initiative seeks to ensure methods are endorsed, meet the statistical community's standards, and help countries apply EO to SDG.

By 2024, develop examples of fifteen (or more) indicators using Earth observations.

The Initiative seeks a spread across environmental, social, and economic themes.

Produce five (or more) examples on uses of Earth Observations for SDG Targets.
The Initiative strives to broaden application of EO to inform the Goals and Targets, in hopes of encouraging other GEO Work Programme activities to follow suit.

Advance 25% of country pilot projects by one Method Useability Level (MuL) - see Appendix C; deliver one project per year to MuL 7 in 2019-2021, and show three new EO products in planning by 2022.
The Initiative promotes demonstrable progress in the development of methods and their sustained, widespread utilization by countries for SDG monitoring and reporting, while

encouraging new data and information collection.

Advance the development of fifteen SDG examples completed under other GEO Work Programme Activities.
The Initiative promotes good practice examples of EO uses with SDG developed under other GEO Work Programme Activities independent of (or with guidance from) EO4SDG.

Develop a SDG EO/GI interactive knowledge resource.
The Initiative seeks to develop its website into a dynamic resource that provides information on data sources, platforms, metadata guidelines, best practices, and country experiences per SDG target and indicator that is supported by Earth observations.

Goal II improves underlying capabilities with Earth observations, focusing especially on support to countries and stakeholders in the implementation of methods using Earth observations to address the *2030 Agenda*. The goal includes activities to coordinate and foster capacity building to effectively employ methods, enable data awareness and access, and sustain use of Earth observations in the context of the SDGs. The goal spans human, scientific, technological, organizational, institutional, and resource-based capacities.

Efforts to develop capabilities to substantiate and quantify the social, environmental, and economic benefits from Earth observations in serving the SDG are included, especially as this articulation may contribute to greater uptake. Activities to develop capabilities within GEO and the Earth observations community about SDG statistical principles and practices are included, as are new capabilities to use data visualization methods to support alternatives analysis and planning regarding the SDGs. This initiative will also serve to "federate" all of GEO's community Activities, Initiatives and Flagships that include an SDG element so as to increase SDG-related knowledge sharing across the GEO Work Programme.

The following are objectives under Goal II:

By 2024, engage twenty (or more) countries in trainings.
The Initiative ensures continuous geographic breadth (including representation per continent).

Produce and share valuations and impact assessments of fifteen methods with GEO members, partners and the wider international community.
The Initiative strives to ensure the methods are valuable in addition to being sound.

Roll-out a SDG toolbox for Earth observation data by 2020 as part of the SDG EO/GI knowledge resource

The Initiative supports capacity development through functional tools, which will also be integrated into other vehicles (e.g., the Federated System of UN SDG Data Hubs, the UN Sustainable Development Solutions Network).

Document national experiences and good practices including case studies, and maintain a handbook on SDGs and Earth observations.
The Initiative provides a platform for knowledge sharing across all GEO Work Programme activities that include an SDG element, and the broader EO/GI and statistical communities.

Goal III addresses outreach, engagement, and communications to showcase effective uses of Earth observations to achieve benefits and positive impacts, thereby encouraging nations and

stakeholders to pursue uses themselves. Traditional and innovative approaches are included to convey achievements and quality stories about roles of Earth observations and GEO to serve development goals. In communicating examples and successes, the Initiative emphasizes where nations and stakeholders clearly gain from their use of Earth observations for the SDGs. The materials showcase the nations and stakeholders and the benefits they achieved. Communication efforts on the progress of the Initiative overall are included. Outreach and engagement activities include efforts to support user-generated method ideas, refinement of the ideas, and brokering connections between users and technical experts. The goal involves innovative work to visualize and convey status and trends in progress toward the SDGs. A foundational element of this Goal is to increase awareness of the need for open data and information, especially in underserved communities and emerging economies, to enable decision makers at all levels to make better use of Earth observations.

The following are objectives under Goal III:

Starting in 2019, issue annual awards on uses of Earth observations for SDG.
The Initiative recognizes excellence and innovation, generating examples that users can consider and pursue.

Produce videos, handouts, and podcasts on three SDG by 2020 and seven by 2021.
The Initiative seeks a spread across social, environmental, and economic themes.

Organize special issues, and publish one or more articles per year, in popular and scientific/trade literature on Earth observations and SDGs.
The Initiative shares examples about effective ways to apply Earth observations to the SDGs.

Continue conducting one or more events at UN, GEO, scientific conferences, and trade shows in 2019-2024.
The Initiative demonstrates benefits of Earth observations for the SDG at places where users gather.

Arrange partnerships with two major entities at the nexus of science, decision support, and sustainability.
The Initiative supports institutions and leverages assets to achieve mutual benefits.

Produce annual reports and a 5-year Summary Report.
The Initiative documents activities and conveys smart practices.

IMPLEMENTATION ELEMENTS

This section describes the primary implementation elements to address the goals and objectives. The EO4SDG Initiative maintains four elements as lines of business: Projects, Capacity Building, Data and Information Products, and Outreach and Engagement. Each line serves each of the goals and contributes to the objectives. Some lines may have desirable overlaps and synergies with other lines, and they collectively address technical, organizational and programmatic aspects of the Initiative.

The EO4SDG team of GEO Member Countries, Participating Organizations, and additional contributors pursues these implementation elements in partnership with suitable, apposite organizations (see Stakeholder Engagement).

The seventeen Goals of the *Agenda 2030* entail 169 Targets and 232 Indicators in the Global Indicator Framework. Some Goals, Targets, and Indicators are well-suited for Earth observations support. In some cases, Earth observations can directly serve an Indicator. In others, Earth observations may provide ancillary information toward indirectly serving an Indicator. Still, in others, Earth observations may not meet the stated Indicator, yet they can contribute to progress on the associated Target (and the results will show up in the Indicator). Figure 1 in Appendix A presents an analysis carried out by GEO, which identifies 72 (42%) Targets and 30 (13%) Indicators where Earth observations can contribute to as a direct measure or as indirect support. Based on this analysis, SDGs 6: Clean water and sanitation, 11: Sustainable cities and communities, 14: Life below water, and 15: Life on land are identified as offering the greatest opportunities for the application of EO data. This appendix also includes Figure 2, which describes alignments of the seventeen Goals with specific types of Earth observations and geospatial information.

In addition, Figures 3 and 4 in Appendix A demonstrate results from an analysis carried out by the UN IAEG-SDGs WGGI. This includes a shortlist of 15 indicators where GI/EO, together with statistical data, can contribute directly to the production of these indicators (Figure 3); and, a shortlist of nine indicators where GI and EO significantly support the measurement of these indicators (Figure 4). EO4SDG is in the process of conducting an in-depth review of the contribution of EO to the SDG Indicators based on the metadata information provided by the IAEG-SDGs in 2018. This review will further consolidate the initial analysis done by both GEO and WGGI with the objective to produce factsheets for all relevant Indicators.

The EO4SDG Team uses these assessments to guide its foci during implementation.

Projects
The EO4SDG Initiative directly supports and pursues projects for method development, distribution, and adoption. The Initiative also provides technical and other guidance for projects developed under other GEO activities, serving a coordination role in a federated approach to GEO's overall service to the SDGs.

Collectively, this portfolio of projects develops and deploys uses of Earth observations to support the tracking of, and reporting on, the SDGs, including integration with national statistical accounts for the indicators. The projects conceive, develop, test, and validate relevant methods, building on proven, existing methods and applications when appropriate. Projects and methods may range from traditional and practical approaches to novel and innovative ones.

Projects encompass simple feasibility studies, pilot projects, and in-depth endeavors. As projects mature, their activities address suitability assessments, sensitivity analyses, frequency testing, and other factors to characterize uses of Earth observations and their appropriateness across users[3] and regions. Their activities may involve innovative uses of visualizations, dashboards, infographics, and graphic design approaches to communicate status and trends in SDG indicators.

Some project activities may focus on one country and address several SDG indicators; others may focus on a particular SDG indicator and apply it to several countries. Overall, the Initiative pays particular attention to the ability to scale a method to multiple nations or stakeholders on a regional or global scale. In addition, the Initiative emphasizes the strong collaborations that projects must have with the statistical community at national and global levels.

The range of activities in the GEO Work Programme provide multiple ways for GEO and Earth observations to support to the SDGs. As part of a federated approach, the EO4SDG Initiative serves a communication function to share smart practices and provide guidance, encouraging consistent approaches and quality standards. Collectively, the projects contribute to enhance the global knowledge and capacity on how to use Earth observations in the implementation and monitoring of the SDGs.

Building on these projects, the EO4SDG initiative documents and broadcasts examples, case studies, lessons learned, and smart practices using Earth observations with the SDG indicators. The initiative identifies and conveys feedback from user organizations on their experiences with and recommendations for Earth observations data and derived information, such as formats and access. The projects include efforts to support qualitative and quantitative evaluation on the broader benefits of Earth observations to enable societal benefits. The projects also aim to illustrate how Earth observations can be employed in the development and implementation of policies and programs that extend beyond the SDGs.

Capacity Building

A portfolio of capacity building activities provides support to institutions and individuals in the ideation, development, and implementation of methods. The activities build capabilities directly with the SDG methods and more broadly with accessing and applying Earth observations. Activities here draw on and contribute to GEO's established capacity building activities and expertise, and they may examine inventive approaches, such as social media, to support the testing and refinement of methods by users.

This element supports the use of Earth observations for the SDGs in all aspects, such as planning, tracking, and reporting. The portfolio includes virtual and physical activities, such as trainings, webinars, joint projects, applied research, and workshops, among many other successful capacity building practices. The element uses and supports GEO's efforts to characterize user needs, especially in fostering effective ways to enable sustained uptake of the methods and related data access.

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[3]E.g., the UN Habitat, the United Nations Environment Program (UNEP), the U.S. Census Bureau, the National Statistics Office in Colombia (DANE), Institute of Hydrology, the Institute of Meteorology and Environmental Studies in Colombia, the National Authority of Water in Peru (ANA), the Ministry of Agriculture, Livestock, Fisheries and Irrigation in Kenya, among others.

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Given the basis of the SDGs in statistical data, this element includes engagement with the SDG statistical and geospatial communities about Earth observations, as well as capacity building within GEO and the Earth observations community about SDG statistical principles and practices.

Data and Information Products

The element encompasses a portfolio of activities advancing the provision, access, discoverability, and applicability of Earth observations and geospatial information for use with the SDG. The element draws on GEO's efforts to characterize user needs, especially in the collection of information from SDG user organizations about data characteristics, usability, preferred formats, etc. to help GEO refine approaches to enable greater use of Earth observations for the SDG. This element especially includes efforts to provide feedback from user communities in less-developed areas about data and information products, as well as EO-enabling tools and platforms. It also helps develop recommendations about how global datasets of information products provide a source of information for countries, in the absence of, or to complement, national data sources. This is very relevant for countries that face major difficulties in collecting national data.

The activities in this element support GEO's efforts to promote and encourage open data policies. In particular, this element focuses on open availability of data and information products where achievement of SDG needs multi-national or regional approaches and coordination. The element includes data visualization methods to support alternative analysis and planning regarding the SDG. The element assesses data and information needed to be available, working with GEO data activities and others to improve discovery, access, and usability. This element also supports activities to identify and enable new observing systems, data acquisition, and exploitation of a wide range of data types and sources– including global datasets of information products in the absence of, or to complement, national data sources – supporting data systems enabling this. EO4SDG is working with other GEO Work Programme activities (e.g., GEOGLAM) to set up a framework for assessing the availability and applicability of fit-for-purpose datasets, including their accuracy, latency and other specifications, to SDG indicators and inform relevant decisions. In addition, this element supports development of guidance to enable end-users to mainstream "analysis ready" EO datasets into national statistical processes and systems, in close collaboration with CEOS.

Outreach and Engagement

This element focuses on outreach and engagement to encourage nations and stakeholders to use Earth observations as part of their SDG activities. Working closely with the other elements, this element includes the creation and maintenance of a portfolio of materials that showcases effective methods, available capacity building support, and accessible data and information products to promote the consideration and adoption of Earth observations for the SDGs by nations and stakeholders. Appendix B describes how the Initiative envisions to turn its website into an interactive knowledge tool designed to facilitate the accessibility and dissemination of information, lessons learned, products and other material. This element also encourages collaboration between GEO and stakeholders in developing new methods and approaches.

The materials include a range of traditional to innovative approaches for outreach and engagement. For instance, a series of thematic examples can articulate how Earth observations

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relate to specific SDGs and can be integrated with traditional statistical approaches; these examples also support efforts by GEO member countries to engage with their own national statistical offices. Additional outreach and engagement activities envisioned include events, such as workshops and sessions at key conferences; trainings, including webinars and hands-on sessions; awards for innovative uses of Earth observations to advance the SDGs; and publications, such as a handbook or library of guidance handbooks on uses of Earth observations with SDG indicators. The element also pursues social media and crowdsourcing to solicit ideas and support the testing and refinement of methods by users.

PAST ACHIEVEMENTS

In 2016-2019, EO4SDG has made progress on a range of the quantitative breakdown objectives set against its three goals, outlined in the 2016-2020 Implementation Plan.

The Initiative has been instrumental in helping UN custodian agencies enhance their SDG indicator monitoring guidelines through the use of Earth Observations, leading to advancements in global method development and data availability. In particular, collaborations with UN Environment on Indicators 6.6.1 (spatial extent of water-related ecosystems) and 6.3.2 (ambient water quality), with UNCCD on Indicator 15.3.1 (proportion of degraded land per total land), and with UN Habitat on Indicator 11.7.1 (average share of the built-up area of cities that is open space for public use) enabled these 4 indicators to be recognized as conceptually clear, with internationally accepted methodologies with EO integrated as notable inputs. In addition, EO4SDG contributors provided input to UN Habitat's SDG 11 Synthesis Report 2018 on *Sustainable Cities and Communities*.

EO4SDG has conducted several pilot projects in support of SDG method development, distribution and adoption by countries and through the UN system. Examples of such pilot activities include, among others:

- A project on using Earth observations to monitor changes in the spatial extent of wetlands in Uganda (SDG Targets 6.6, 15.1). This project is led by the Ramsar Center in East Africa in collaboration with the European Space Agency (ESA), the Bureau of Statistics in Uganda, and the GEO Wetlands Initiative, among other contributors.
- A project on integrating Earth observations and national statistics for mapping changes in urban extent, population, and Indicator 11.3.1, which tracks the ratio of land consumption rate to population growth rate. This project is led by NASA and Conservation International, in collaboration with UN Habitat and countries (e.g., Colombia, Mexico, Morocco, others).
- Pilot activities in support of the use of EO for monitoring SDG 6 (Clean water and sanitation) and in particular: changes in spatial extent and quality of open water bodies. This is a collaborative effort among the UN Environment Programme, individual countries (including Zambia, Uganda, Colombia, Peru, United Arab Emirates, Malaysia), NASA, the European Commission's Joint Research Center (JRC), ESA, and Google Earth Engine, among others. EO4SDG has been working with UN Environment and other activities of the GEO Work Programme to assist countries in using Earth observation data to not only measure relevant indicators, but to also take action toward protecting water-related ecosystems.
- A project to develop capacity for implementing the Mexican Geospatial Data Cube, a collaboration between Mexico (INEGI) and Australia (Geoscience Australia). This project aims to enable processing and analysis of Earth observations to help generate useful data for INEGI's national resource information production, surveys, censuses, and in support of SDG analysis and reporting.

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- A project led jointly by JAXA and the Japan International Cooperation Agency (JICA) involving the implementation of a 'Forest Early Warning System in the Tropics (JJ-FAST)'. This web-based system monitors tropical forests every 1.5 months. As of June 2018, the system's service coverage was expanded to include seventy-seven countries.

As part of its federated approach, EO4SDG has been working with other GEO thematic activities to identify opportunities for connecting relevant information products, applications, and services with respective SDG targets and indicators. GEO Blue Planet, in collaboration with EO4SDG, is working with UN Environment to develop an inventory of existing marine litter databases and data sets in support of indicator 14.1.1, Index of coastal eutrophication and floating plastic debris density. GEOGLAM, in collaboration with EO4SDG, is working to set up a framework for assessing the availability and applicability of fit-for-purpose datasets to measure relevant indicators and inform decisions. EO4SDG, Human Planet, and the Global Urban Observation and Information Initiatives are working with UN Habitat and countries to improve urban SDG monitoring via harmonization of urban definitions, provision of datasets, technologies and tools, and capacity development activities that are essential for the implementation of SDG 11 (Sustainable Cities and Communities). In addition, EO4SDG cooperates with regional GEO initiatives (e.g., AmeriGEO) to leverage existing partnerships at regional to national and local levels, and increase the use of EO in regional SDG framework activities.

The Initiative has been improving capabilities with Earth observations, supporting countries and stakeholders in the implementation of methods using EO to address the 2030 Agenda.

As part of the Eighth Session of the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM), EO4SDG collaborated with UN-GGIM Americas, Mexico (INEGI), the NASA Applied Sciences Remote Sensing Training (ARSET) program and CEOS to run a training workshop focused on water, land cover, land degradation, and their related SDG indicators. In addition, a 2018 workshop on "Implementing and Monitoring the Sustainable Development Goals in the Caribbean: The Role of the Ocean," brought together GEO Initiatives (including EO4SDG), governments of the Caribbean Small Island Developing States, UN Agencies, and regional non-governmental organizations. This led to the development of a "geospace for SDGs", a grass-root driven, bottom-up approach complementary to the government-driven, top-down approach to the implementation of the 2030 Agenda.

EO4SDG developed a handbook to highlight case studies of how EO respond to sustainable development needs, and contributed input to CEOS' Handbook on "Satellite Earth Observations in Support of the Sustainable Development Goals". The Initiative has also been working closely with the CEOS SDG Ad Hoc Team and the CEOS Working Group on Data Democracy and Capacity Building to organize SDG awareness webinars. EO4SDG contributors, including NASA ARSET and Conservation International, organized a series of webinars on the use of EO to monitor land degradation and sustainable cities and their respective SDG, with participation from UN Habitat and UNCCD.

In addition, the Initiative completed an in-depth review of the contribution of EO to the Global Indicator Framework, based on the metadata information provided by the IAEG-SDG in 2018. This review further consolidated the initial analysis completed by EO4SDG and the WGGI, including: a detailed compendium on Earth observation contributions to SDG indicators; accompanying indicator factsheets; and a companion policy brief. This material is currently under review and will be made available through the Initiative's web portal during fall 2019.

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To identify and map how GEO Member Countries are using - or planning to use - EO data for the SDG, the EO4SDG team, in collaboration with the GEO Secretariat, conducted a survey of SDG user needs. The Initiative received seventy-two unique responses from GEO Members, with a large majority coming from governmental agencies, commonly environmental, geographical or statistical. EO4SDG developed a report that summarizes key findings from this survey, including lessons learned, challenges, and recommendations for advancing the use of EO for SDG analysis and reporting. The Initiative plans to organize a side meeting at the GEO Week 2019 to showcase the survey findings, including use cases of GEO Members that are using EO to inform SDG targets and produce indicators.

EO4SDG has engaged in efforts that support the development of tools and platforms that enable integration of EO into national data streams and decision support systems. Examples of such efforts include the Trends.Earth Urban Mapper [https://geflanddegradation.users.earthengine.app/view/trendsearth-urban-mapper] that helps analyze changes in urban extent and population growth with the added capability of enabling users to set baselines; access global EO datasets; and upload and use the best-available, local information. Another example is the SDG661 application [*sdg661.app*], developed by UN Environment in collaboration with Google and the JRC. EO4SDG is working with UN Environment to identify additional global EO datasets that can be incorporated in this application to support official sub-national, national, and global level monitoring and reporting.

The Initiative has conducted, and participated in, several events at UN, GEO, and other scientific conferences including: the annual UN Statistical Commission meetings, the UN High Level Political Fora, the UN-GGIM and UN-GGIM Americas annual events, the UN World Data Forum, the American Geophysical Union and the IEEE Geoscience and Remote Sensing Society, among others.

To support the collection of EO solutions that enable countries to achieve the 2030 Agenda and the SDG, EO4SDG and the CEOS SDG Ad-Hoc Team organized two special issues in the Remote Sensing, and the Remote Sensing of Environment, Scientific Journals. Furthermore, in collaboration with the GEO Secretariat, EO4SDG developed a book on *Earth Observation Applications and Global Policy Frameworks*, with a focus on disaster risk reduction, climate change, and sustainable development. The book, currently under formal review, will be published in the American Geophysical Union (AGU)'s Geophysical Monograph Series. More information on additional outreach activities is available at the Initiative's website (http://eo4sdg.org) under 'What We Do' and 'Get More Information', and via our active Twitter account, @EO4SDG.

In 2019, EO4SDG initiated the first call for nominations for the GEO SDG Awards to recognize productivity, ingenuity, proficiency, novelty, and exemplary communications of results and experience in uses of EO with the SDG. The Initiative plans to share information about nominated organizations' EO-based SDG endeavors openly, to encourage further use of EO for the SDG.

STAKEHOLDER ENGAGEMENT

At the global level, the UN Statistical Commission is the oversight body of SDG efforts supported by the UN Statistical Division (UNSD). In 2015, the UNSC created the Inter-agency Expert Group on SDG Indicators (IAEG-SDGs) to develop and implement the global indicator framework for the Goals and Targets of the 2030 Agenda. To tackle specific topics relevant to the SDG Indicator implementation, the IAEG-SDGs formed the Working Group on Geospatial Information (WGGI).

EO4SDG participates in the WGGI and is actively involved in supporting a task stream of this working group titled, "Application of Earth Observations for SDG Indicators."

SDG custodian agencies, usually UN bodies (and in some cases, other international organizations), are responsible for compiling and verifying country data and metadata for specific indicators, and for submitting the data, along with regional and global aggregates, to UNSD. The agencies are also responsible for developing international standards and recommending global monitoring methodologies to enable comparability across country data on SDG indicators.

EO4SDG, and the broader GEO community, work closely with custodian agencies on method development, testing, refinement, adoption, and widespread, sustained use.

EO4SDG collaborates with global initiatives that facilitate the dissemination of best practices and promote integrated approaches to address the economic, social, and environmental aspects of the 2030 Agenda. Examples of such initiatives include: the UN Sustainable Development Solutions Network (SDSN), the UN Committee of Experts on Global Geospatial Information Management (UN-GGIM), and the Global Partnership for Sustainable Development Data (GPSDD).

Overall, EO4SDG enables countries and organizations to leverage Earth observations to support the implementation, planning, measuring, monitoring, reporting, and evaluation of the SDGs and their normative societal benefits.

Countries are at the center of SDG monitoring and reporting and oversee the SDG process via their national statistical systems, line ministries, and other national institutions. National statistical systems, and in particular national statistical offices (NSOs), play a pivotal role in this process, and in particular, in the areas of data collection, coordination, validation, and reporting of statistics for the SDGs.

At the national level, it is essential for the GEO representative organizations to engage with the respective NSOs in their efforts to extend EO uses in national SDG analysis and reporting. In addition, communication with national mapping agencies (NMAs) is key to enable the sharing of information and proper guidance on the quality and quantity of official geospatial data of SDG relevance, available at country level.

The EO4SDG Initiative pursues partnerships as a key element of the strategic implementation, leveraging knowledge, resources, and skills of partner organizations in collective support of the SDGs. The Initiative focuses on organizations with sound activities related to the SDGs, working with established GEO partners and seeking to expand GEO's set of partners where possible. Involvement of the individual GEO Member Countries and Participating Organizations is central to the Initiative's activities, including efforts to support the engagement of and collaboration with national statistical offices. The Initiative seeks to enhance GEO's strong relationship with the United Nations and continuously engages and informs the global Earth observations and geospatial information communities of developments and opportunities. Some key additional potential partners include development banks, non-governmental organizations, learned societies, corporations, foundations, and civil society.

Engagement and partnership with these entities help build processes, mechanisms, and human capacity to include Earth observations in national development plans and to integrate them with national statistical accounts to improve the measuring, monitoring and achievement of the SDGs. These partnerships and collective efforts can support broader societal ownership of the Goals and Targets to strengthen the effectiveness and accountability of their implementation.

Key organizations that the EO4SDG has pursued partnerships with include the following, adding others over the course of the initiative:

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Sustainable Development Solutions Network, SDSN

The SDSN is a UN-sanctioned body mobilizing global scientific and technical expertise to promote practical problem solving for sustainable development. Supporting the implementation of the SDGs at all scales, SDSN promotes integrated approaches to interconnected social, economic, and environmental challenges. With national and regional networks, SDSN promotes Solutions Initiatives to accelerate progress toward sustainable development. *http://unsdsn.org*

GEO participates in the SDSN Thematic Research Network on Data and Statistics, TReNDS, which convenes cross-sector technical and policy knowledge from across the global scientific, development, public. The EO4SDG Initiative plans to work more closely with SDSN to support the broad distribution of successful, productive methods to use Earth observations and geospatial information for the SDGs and sustainable development decisions overall.

UN Committee of Experts on Global Geospatial Information Management, UN-GGIM

The UN-GGIM is a UN intergovernmental entity which guides the making of joint decisions and sets directions on the production and use of geospatial information within national and global policy frameworks. UN-GGIM provides a platform for the development of effective strategies to strengthen national capacity on geospatial information, disseminates best practices, and promotes the use of geospatial information to address

The EO4SDG Initiative partners with UN-GGIM and its Secretariat to work effectively with the UN Statistics Division, IAEG-SDG, and other UN System entities. A collaboration with the UN IAEG-SDG WGGI pursues opportunities for disseminating smart practices, documenting effective methods and successful projects, and developing guidelines to facilitate the integration of EO into national information systems and SDG monitoring processes.

Global Partnership for Sustainable Development Data

The Global Partnership for Sustainable Development Data is a global network of governments, NGOs, and businesses working together to strengthen the inclusivity, trust, and innovation in the way that data is used to address the world's sustainable development efforts. The Global Partnership supports data-driven decision-making by initiating more open, new, and usable data. *http://www.data4sdgs.org/*

The EO4SDG Initiative works with the Global Partnership on the openness, availability, and usability of Earth observations data and geospatial information to support the SDGs. EO4SDG has been working with GPSDD on its country-level data roadmap process, which focuses on developing and implementing whole-of-government, multi-stakeholder data

roadmaps for sustainable development at both national and sub-national levels. EO4SDG is providing resources and expertise to more directly engage with countries on meeting key data gaps and challenges. Country examples include Colombia, Kenya, Senegal and Ghana, among others.

International Institute for Sustainable Development, IISD
IISD promotes human development and environmental sustainability through research, communication, and partnerships. IISD provides practical solutions to the challenge of integrating environmental and social priorities with economic development. IISD's work covers strategies, policy advice, and tools across a range of programs and topics. IISD is a GEO Participating Organization. *http://iisd.org*

The EO4SDG Initiative will pursue collaboration with IISD to support the broad distribution of productive methods to use Earth observations and geospatial information for the SDGs and sustainable development decisions. A partnership can support efforts to integrate Earth observations into government policy and public management practices as well as strong outreach and communications activities.

The EO4SDG Initiative collaborates with other activities in the GEO Work Programme that have established, or potential, connections to the SDGs. To date, EO4SDG has worked closely with GEO Blue Planet, GEOGLAM, GEO AquaWatch, GEO Wetlands, Human Planet, AmeriGEO, GEO Cradle, and the newly formed GEO-LDN Initiative. Moving forward, EO4SDG plans to organize consultations with additional Initiatives, in collaboration with the GEO Secretariat, to increase SDG-related knowledge sharing and promote the development of SDG examples completed under other GEO Work Programme activities.

The Initiative also pursues partnerships with major scientific unions and management-oriented associations. Examples include the IEEE Geoscience and Remote Sensing Society (IGARSS) and the American Geophysical Union (AGU). Organized efforts with these groups can integrate the sustainable development goals in the context of these organizations' duties. They can include and feature the SDGs in their meetings and conferences, allowing opportunities to engage researchers, technicians, managers, and others to inform and energize them and catalyze contributions.

EO4SDG also engages with the private sector to explore and leverage existing platforms and initiatives that help track progress, identify priority areas for action, and enable broad community engagement while leveraging a wide range of data sources, including Earth observations. Examples include Esri, a private sector company specializing in Geographic Information System (GIS) mapping, as well as Google Earth Outreach and Google Earth Engine, which use and develop Google's infrastructure to address global environmental, health and humanitarian issues. Furthermore, the European Association of Remote Sensing Companies (EARSC) - a professional industrial body with the mission to foster growth of the EO services sector – is an active EO4SDG contributor.

Schedule

The EO4SDG Initiative has general events and activities that occur every year and ones specific to a given year. Examples of events and activities include GEO Plenaries, UN Statistical Commission meetings,

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conferences, annual meetings, trainings, workshops, and webinars, among others. In addition, the Initiative may hold special events, such as a biennial conference of the partners.

The following is a list of recurring annual events that are part of a general schedule:

QI: January - March
UN Statistical Commission meeting

QII: April - June
EGU and JpGU meetings
GEO Work Programme Symposium

QIII: July-Sept
UN High Level Political Forum
UN-GGIM Annual Meeting
EO4SDG Annual Meeting

QIV: October - December
UN-GGIM Americas
GEO Plenary & EO4SDG Side Events
UN World Data Forum
AGU meeting

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GOVERNANCE

This section describes the management of the EO4SDG Initiative, including governance, internal communications, schedule, and evaluation. Overall, there are three active levels of involvement in EO4SDG: Community, Team, and Leadership. The Community includes the broad universe of people who are interested in GEO's activities with the SDGs, but are not necessarily involved in any specific activity. The Team includes those people who are directly involved with EO4SDG activities. The Leadership, as described below, is a subset of the EO4SDG Team - a core group of people leading and managing the EO4SDG Initiative.

The EO4SDG co-leads —the U.S. [NASA], Japan [JAXA], and Mexico [INEGI] — provide a facilitation role, guide agenda-setting, set priorities and make decisions, as necessary. An executive secretary, supported by the U.S. (NASA), coordinates with the co-leads and EO4SDG members, as well as with projects and other activities as needed to expedite the EO4SDG workings, progress, and results. In 2016-2018, a GEO Secretariat point of contact collaborated with the co-leads and the Executive Secretary to advance the Initiative's goals and objectives.

By monthly calls, outreach meetings, and projects, EO4SDG interacts proactively with GEO Members, Participating Organizations, other GEO Work Programme activities, as well as custodian agencies responsible for SDG indicators of relevance to their thematic expertise or mandate. The Initiative forms standing bodies to address on-going functions (developing pilot projects, methods, and products, capacity development, communications, and publications, etc.), as well as ad hoc groups, as needed, for special activities, topics, and events that arise. Standing bodies address strategic planning, membership, projects, capacity building, data and information, outreach, partnerships, evaluation, and reporting. Interaction among standing bodies is encouraged and expected.

Moving forward, EO4SDG will form a Board to provide corporate-level oversight and serve corporate interests of the Initiative. The Board will aim to track functions that support operations and enable the Initiative to be productive, spanning strategic direction-setting to tactical aspects. The EO4SDG co-leads will head the Board, which will be comprised of individuals (anticipated to be 8-10 individuals) committed to the Initiative. Board members will represent their respective country or organization. They (or their country or organization) will be expected to actively participate in EO4SDG Initiative activities. Members of the Board will serve on at least one standing body, and on ad hoc groups as needed. Board members are expected to actively support one or more major Initiative activity per year, contribute to an EO4SDG annual report, and attend annual meetings. Geographic and gender balance of the Board will be a priority.

The Initiative will periodically make calls for nominations, and members of the EO4SDG Team can nominate themselves to be on the EO4SDG Board. The Board will review nominations and make selections of new Board members. At an annual meeting each year, Board members can nominate themselves to be co-leads. Subsequently, the Board will review nominations for co-leads and select the new, incoming co-leads, who will assume the role after a brief transition period with the outgoing co-leads. Co-leads will serve staggered terms to ensure continuity in the leadership of the Initiative.

Internal Communications
The Initiative Leadership Team holds routine teleconferences to review status and progress reports of EO4SDG activities. Standing bodies provide routine status reports, and Team members identify new topics

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and opportunities. The executive secretary and co-leads develop the teleconference agendas with input from Team members, and the executive secretary provides a summary.

There is an annual, in-person team meeting for the EO4SDG Initiative. The annual meeting reviews the Initiative in depth and provides a key time to evaluate the Initiative (see Evaluation below). The annual meetings provide dedicated time for attendees to address and resolve major issues requiring longer discussions than the status teleconferences provide. The annual meetings involve the partners, and the meetings are open to the broad EO4SDG Team and Community.

As needed, the EO4SDG Team and its standing bodies arrange in-person meetings in conjunction with major GEO events, such as the GEO Plenary and the GEO Symposium. As possible, these meetings allow teleconference capabilities for Team members not present at the event.

The Initiative may arrange special meetings to address GEO requirements and requests, such as input to GEO Plenary documents or Work Programme revisions.

The Initiative is planning to hold more regular open teleconferences or webinars for the broader EO4SDG community. These open teleconferences and webinars will provide the community with information on the Initiative, new activities, directions, opportunities for support, and other topics.

Evaluation

The annual meeting (and preparations for it) serves as the primary event for the Leadership, Team, and Community to reflect on the Initiative – its progress, its challenges, and its direction. The attendees review projects and activities, discussing successes as well as items that did not go as planned. Attendees assess progress and performance with respect to expectations, review resource needs, and evaluate the Initiative's ability to execute plans with acceptable risk.

This event provides an opportunity to evaluate whether the functional and performance requirements for the Initiative are properly formulated, responsive to GEO objectives, and represent achievable capabilities; assess the credibility of the Initiative's targets and schedule; and set or revise targets and the schedule for the upcoming year. A key decision for each annual meeting is the status of the Initiative and whether to recommend changes to the GEO Programme Board.

Standing bodies also conduct evaluations of their respective functions. They report at periodic teleconferences as well as the annual meeting.

Performance
A key measure of the Initiative's performance is the achievement of the objectives for the three EO4SDG goals. The team will strive to achieve all of them, and it recognizes that the complete set serves as an ambitious target. At the half-way mark of this implementation plan, the team will assess the Initiative's performance and make adjustments to activities and expectations.

Largely, the EO4SDG initiative promotes the uptake of Earth observations and geospatial information by nations and stakeholders in SDG planning, tracking, and reporting. Such use is through sound, accepted SDG methods. A primary focus of the Initiatives performance is the enablement of these methods in their development and use, which inherently includes the capacity building, data and information products, and outreach activities of EO4SDG.

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The EO4SDG team employs a seven-stage metric to track the maturation of SDG methods using Earth observations and geospatial information. This Method Useability Level (MUL) index provides a scale for the expected advancement along a continuum – from initial idea, through development and field testing, to adoption and sustained utilization. The MUL index allows the EO4SDG team to convey expectations for project and method development, assess progress and diagnose problems, and report on EO4SDG performance both for individual projects and the overall portfolio. Appendix C provides additional information on the MUL index and the definitions for each level.

Communications

In addition to outreach focused on encouraging nations and stakeholders to use Earth observations for the SDGs, the EO4SDG Initiative conducts broad activities to communicate progress of the Initiative overall. The Initiative communicates achievements and quality stories as ways to inform the global community about GEO, Earth observations, and GEO's activities to serve development goals. The Initiative regularly informs the EO4SDG team and community of its progress, potentially encouraging community members to become more involved in activities. And, the Initiative communicates with the GEO community, partners, and stakeholders to demonstrate GEO activities and achievements in the use of Earth observations to provide societal benefits.

The Initiative works with the GEO communications team and others to prepare stories, infographics, and messages; coordinate with partners; and support communications across appropriate channels. These efforts include the creation and maintenance of a portfolio of materials, such as examples, stories, articles, and web features. These materials are ones the EO4SDG team and community can use to broadcast EO4SDG activities, progress, and successes broadly. Appendix B describes a web-based resource tool designed to facilitate the accessibility and dissemination of information, lessons, products and other material. Development of this tool will be dependent on the availability of human, technical and other resources to design, populate and maintain it.

The Initiative plans to articulate a communications plan in a separate document, including a message frame, audiences, and channels. The team will update this plan as needed, with a review at least once a year at the annual meeting. The Initiative's two-year schedule includes key communications activities.

RESOURCES

The EO4SDG Initiative operates through in-kind contributions of financial and other resources to conduct its activities. As in-country pilot projects and other activities articulated in each two-year EO4SDG Work Plan, the Initiative develops a clear statement of the types of resources the EO4SDG Team is prepared to commit to successfully implement the Initiative. While specific resource allocations depend on the needs of a given project or activity, it is critical that representatives of EO4SDG be able to demonstrate to potential country-level partners a strong commitment to engaging in collaborations early in the development of the projects.

Resources can take multiple forms, including:

- Engagement by staff and officials from EO4SDG participating organizations in planning, oversight, and management of EO4SDG activities;
- Provision of data resources and other technical capabilities to pilot countries;
- In-kind services related to capacity development training sessions and materials; and,
- Publications and other communication material related to EO4SDG activities.

The Initiative leverages existing capacities and focuses on streamlining existing programmes and funding schemes for SDG-relevant EO products, tools, and platforms.

DATA POLICY

The initiative directly conducts projects for method development, distribution and adoption. The data contributed to national SDG measuring and monitoring efforts may be extant in the Global Earth Observation System of Systems (GEOSS), or within the on-going activities of other GEO Community Activities, Initiatives, Flagships, Foundational Tasks and other elements of the GEO Work Programme, or they may be new data resources developed to address specific national/regional needs. The additional data resulting from EO4SDG in-country engagements will reside with the country involved in the pilot project and will contribute to the national reporting requirements on the SDGs mandated by the United Nations. The extent to which the data is made fully and freely available by each government is an internal decision, but the EO4SDG team will make every effort to encourage that the data be made freely and openly available, and subsequently incorporated into GEOSS, in keeping with GEO's Data Sharing Principles.

APPENDIX A: EARTH OBSERVATIONS AND SDG GOALS, TARGETS, AND INDICATORS

This table indicates the most likely Targets and Indicators that Earth observations can contribute as a direct measure or as indirect support.

Figure 1

									Goal					
Target — Contribute to progress on the Target yet not the Indicator per se										Indicator — Direct measure or indirect support				
							1.4	1.5	1	1.4.2				
						2.3	2.4	2.c	2	2.4.1				
					3.3	3.4	3.9	3.d	3	3.9.1				
									4					
								5.a	5	5.a.1				
	6.1	6.3	6.4	6.5	6.6	6.a	6.b		6	6.3.1	6.3.2	6.4.2	6.5.1	6.6.1
					7.2	7.3	7.a	7.b	7	7.1.1				
								8.4	8					
					9.1	9.4	9.5	9.a	9	9.1.1	9.4.1			
						10.6	10.7	10.a	10					
	11.1	11.3	11.4	11.5	11.6	11.7	11.b	11.c	11	11.1.1	11.2.1	11.3.1	11.6.2	11.7.1
				12.2	12.4	12.8	12.a	12.b	12	12.a.1				
					13.1	13.2	13.3	13.b	13	13.1.1				
	14.1	14.2	14.3	14.4	14.6	14.7	14.a		14	14.1.1	14.3.1	14.4.1	14.5.1	
	15.1	15.2	15.3	15.4	15.5	15.7	15.8	15.9	15	15.1.1	15.2.1	15.3.1	15.4.1	15.4.2
								16.8	16					
17.2	17.3	17.6	17.7	17.8	17.9	17.16	17.17	17.18	17	17.6.1	17.18.1			

Sustainable Development Goals — Earth Observations in Service of the *Agenda 2030* (GEO Group on Earth Observations; The Global Goals for Sustainable Development)

This table indicates alignments of the Goals with specific types of Earth observations and geospatial information.

Figure 2

This table presents an assessment of SDG Indicators for which geospatial information has direct contributions (credit: WGGI) and assessment of EO applicability (credit: GEO)

Figure 3

Tier	SDG indicators where geospatial information directly contributes (Assessment by WGGI)	EO Applicability (Assessment by GEO)
Tier I		
9.c.1	Population covered by a mobile network	
14.5.1	Protected areas in relation to marine areas	✔ ☐
15.1.1	Forest area	✔ ☐
15.1.2	Important sites for terrestrial and freshwater biodiversity	✔ ☐
Tier II		
6.5.2	Transboundary basn area	
11.2.1	Population that has convenient access to public transport	✔ ☐
11.3.1	Ratio of land consumption rate to population growth rate	✔ ☐
15.3.1	Proportion of land that is degraded over total land area	✔ ☐
15.4.1	Coverage by protected areas of important sites for mountain biodiversity	✔ ☐
Tier III		
2.4.1	Agricultural area under sustainable agriculture	✔ ☐
6.3.2	Bodies of water with good ambient water quality	✔ ☐
6.6.1	Change in the extent of water related ecosystems over time	✔ ☐
9.1.1	Rural population who live within 2km of an all-season road	✔ ☐
11.7.1	Built-up area of cities that is open space for public use	✔ ☐
14.2.1	National exclusive economic zones managed using ecosystem-based approaches	

This table presents an assessment of SDG Indicators that geospatial information significantly supports (credit: WGGI); and corresponding EO applicability (credit: GEO)

Figure 4

Tier	Indicators that geospatial information significantly supports (Assessment by WGGI)	EO Applicability (Assessment by GEO)
Tier I		
1.1.1	Proportion of population below the international poverty line	
5.4.1	Proportion of time spent on unpaid domestic and care work	
15.4.2	Mountain green cover index	✔ ☐
Tier II		
1.4.2	Proportion of population with secure tenure rights to land	✔ ☐
5.2.2	Women and girls 15 years and older subjected to sexual violence	
5.a.1	(a) Proportion of total agricultural population with ownership or secure rights over agricultural land & (b) share of women among owners or rights-bearers of agricultural land	✔ ☐
5.a.2	Proportion of countries where the legal framework guarentees women's equal rights to land ownership	
Tier III		
11.7.2	Proportion of persons victim of physical or sexual harassment	
Multiple Tier I/II/III		
4.5.1	Parity indices for all education indicators that can be disaggregated	

APPENDIX B: CURATED WEB-BASED RESOURCE ON EARTH OBSERVATIONS FOR SDGS

The EO4SDG Initiative plans to develop its website into an interactive knowledge resource that provides information on data sources, platforms, metadata guidelines, best practices, and country experiences per SDG target and indicator that is supported by Earth observations.

This resource will be modeled after Tables in Appendix A and be curated and regularly updated. This will provide the capability for each SDG to be consulted to determine what EO resources, projects and tools are available for each SDG, Target, and Indicator. The resource will also include references by country/region, and an estimate of the level of maturity achieved for each SDG in terms of: amount of data available, existing methodologies, indicators developed, and the level of coordination with National Statistical Offices (NSOs), as well as the IAEG and the intergovernmental/UN Indicator process.

Data embedded within the resource will include: 1) countries and regions (and other partners) where resources exist or are currently being developed; and 2) a detailed view of the types of data and resources that are being combined to measure a particular Indicator. The information will be color-coded, corresponding to the level of maturity, depending on agreed criteria, similar to those described in Appendix C (MUL levels). The level of maturity will also depend on the institutional maturity (coordination with NSOs, level of acceptance and discussion within the IAEG).

This web resource will help visualize, in graphic, dynamic and geo-referenced form, the state of the art/landscape at the national/subnational, regional and global level. It will include both completed, ongoing and proposed projects and indicators. The resource will also reveal gaps, challenges and opportunities in the SDG landscape t*o stimulate the GEO community to both identify resources to address needs and to propose specific projects to enrich/complement SDG Targets and Indicators using EO and geospatial data.* It will serve as both a tool/resource for the GEO community, and to help illustrate to NSOs, national decision makers, other data producers and the international community of the EO/GEO contribution to the 2030 Agenda and the SDG Indicator framework.

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APPENDIX C: SDG METHOD USEABILITY LEVELS (MULS)

The EO4SDG Initiative introduces a seven-stage metric to track the maturation of SDG methods using Earth observations and geospatial information. This Method Useability Level (MUL) index provides a scale for the expected advancement along a continuum – from initial idea, through development and field testing, to adoption and sustained utilization. The MUL index allows the EO4SDG Task Team to convey expectations for project and method development, assess progress and diagnose problems, and report on EO4SDG performance for both projects and the overall portfolio.

The MUL reflects three main stages in method development. In general, MUL levels 1-2 encompass conception and feasibility; MUL 3-5 address development, testing, and demonstration; and, MUL 6-7 focus on deployment and adoption. Advancements towards MUL 5 (method approval) and MUL 6 (deployment and use) may be pursued concurrently.

The following are the seven MUL levels:

1. Idea and Method Invention
Method invention and formulation of concept begins here. Initial understanding and characterization are articulated for how Earth observations and geospatial information can support the SDG Target and Indicator. The method is still speculative and there is no proof or detailed analysis to support the assumption.
Key milestone: Convincing plan to prove feasibility is established.

2. Proof of Method Concept
Feasibility studies to assess the potential viability of and provide a proof-of-concept for the method are conducted. A more complete characterization of the Target and Indicator and the role of Earth observations and geospatial information is completed. Performance standards are established. An information template on geospatial components for an Indicator is drafted and submitted to IAEG-SDG.
Key milestone: Convincing case for method is made and viability is established.

3. Method Verification and Validation
Basic components of Earth observations and geospatial information are integrated into a prototype method to establish they work together and are tested in a simulated environment(s). At this level, the technical, organizational, and human process issues are considered and worked out, as is the initial standardization of the method. Verification and validation that the information functions to performance standards is achieved.
Key milestone: Potential to address the Target/Indicator is determined and articulated.

4. Field Testing and Refinement
Prototype method is demonstrated and field-tested in relevant user environments for usability (e.g., difficulty vs. expectation, user error rates, data access, etc.). Modifications are made and the method is further refined and standardized to conform to end-users' environments and standard interfaces. Documentation of the method as a standardized process is established. Achieving this level represents a major increase in the method's demonstrated readiness.
Key milestone: Potential to address the Target/Indicator is demonstrated and documented.

5. Method Approval

The completed method is fully characterized and qualified for deployment, including data availability and possible succession plans for data sources. Functionality of the method is demonstrated to win the confidence of the IAEG-SDG. The method is presented for approval by the IAEG-SDG. Upon approval, the method is presented for adoption by the SDSN.
Key milestone: Approval by IAEG-SDG.

6. Deployment and Use

Deployment plan to encourage adoption is established and pursued. Most user documentation, training documentation, and maintenance documentation are completed. Outreach, training, and capacity building about the method are conducted. User experience assessment conducted. Case studies with testimonials developed.
Key milestone: Demonstrated use by 5 countries.

7. Widespread Sustained Utilization

On-going outreach, training, capacity building, and adoption activities are conducted. On-going usability and user experience assessments are conducted. Necessary maintenance, refinements, and improvements of method occur and support is given for any succession of data sources. On-going publication of results and testimonials are conducted. Communication with IAEG-SDG (or successor organizations) via the WGGI (or individual UN Member States) and the UN Statistical Commission is maintained.
Key milestone: Demonstrated use by 20 countries.

Key milestones for each level are listed above. A project's MUL is determined at any given time by the highest level for which all milestones preceding it have been completed in full.

APPENDIX D: GLOSSARY OF SDG-RELEVANT TERMS AND ACRONYMS

UN HLPF
The United Nations High Level Political Forum is the UN central platform for follow-up and review of the 2030 Agenda for Sustainable Development and the SDGs, providing for the full and effective participation of all States Members of the United Nations and States members of specialized agencies.

UNSC
The United Nations Statistical Commission has the mandate for the development and implementation of the Global Indicator Framework. The Statistical Commission oversees the work of the United Nations Statistics Division (UNSD).

IAEG-SDGs
The United Nations Inter-agency and Expert Group on Sustainable Development Goals, established at the forty-sixth session of the UN Statistical Commission, is responsible for developing, reviewing, and supporting the implementation of the Global Indicator Framework, for the Goals and Targets of the 2030 Agenda for Sustainable Development.

WGGI
The United Nations Inter-agency and Expert Group on Sustainable Development Goals Working Group on Geospatial Information, established at the forty-seventh session of the UN Statistical Commission, reports directly to the IAEG-SDGs and is responsible for ensuring from a statistical and geospatial perspective that one of the key principles of the 2030 Agenda, to leave no one behind, is reflected in the Global Indicator Framework.

UN Custodian Agencies
Usually UN bodies (and in some cases, other international organizations), responsible for compiling and verifying country data and metadata for specific indicators, and for submitting the data, along with regional and global aggregates, to UNSD. Custodian agencies are also responsible for developing international standards and recommending global monitoring methodologies to enable comparability across country data on SDG indicators.

UN-GGIM
The United Nations Committee of Experts on Global Geospatial Information Management aims at playing a leading role in setting the agenda for the development of global geospatial information and to promote its use to address key global challenges. It provides a forum to liaise and coordinate among Member States, and between Member States and international organizations.

Tier Classification for SDG Indicators
Tier 1: Indicator is conceptually clear, established methodology and standards are available and data are regularly produced by countries; **Tier 2:** Indicator is conceptually clear, established methodology and standards are available but data are not regularly produced by countries**; Tier 3:** Indicator for which there are no established methodology and standards or methodology/standards are being developed/tested.

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CEOS SDG Ad-Hoc Team
A Committee on Earth Observation Satellites (CEOS) dedicated ad-hoc team that focuses on coordination efforts around satellite Earth observation contributions to the SDGs.
http://ceos.org/ourwork/ad-hoc-teams/sustainable-development-goals/

GPSDD
The Global Partnership for Sustainable Development Data is an open, multi-stakeholder network that focuses on building an enabling environment for harnessing the data revolution for sustainable development.

UN SDSN
The UN Sustainable Development Solutions Network aims to mobilize global scientific and technological expertise to promote practical problem solving for sustainable development, including the design and implementation of the Sustainable Development Goals (SDGs).

IISD
The International Institute for Sustainable Development promotes human development and environmental sustainability through innovative research, communication and partnerships.