Responses to the Questionnaire on Uses of Earth Observation Data for SDG analysis and reporting by GEO Member Countries

March 2020

GROUP ON EARTH OBSERVATIONS

EARTH OBSERVATIONS FOR THE SUSTAINABLE DEVELOPMENT GOALS

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Symbios Communications

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1 Background and Purpose

The GEO EO4SDG team, in collaboration with the GEO Secretariat, conducted a survey of SDG user needs between the 24th of October 2018 and the 18th of December 2018. The objective was to assist EO4SDG identify and map how GEO Member Countries are using - or planning to use - EO data for the SDGs. Survey results will be used to gain insight on the current use of EO for SDG analysis and reporting, and to define areas where EO4SDG and GEO should reinforce these efforts. Responses will also enable the documentation, and promotion, of case studies and best practice examples.

This report provides a brief summary of responses and has been prepared to guide a full submission to the WGGI, and for consideration and inclusion in WGGI's report to the IAEG-SDGs. It presents a summary of responses to each question, and collates and summarizes the open ended responses. A full list of questions is included in the appendix, as well as a table of open ended replies to "Other" comments, and a table of responses to the open ended questions. This report is accompanied with a spreadsheet export of the complete responses to the survey.

The survey was completed by GEO Member Principals or their delegated SDG focal point. The full results are available here: https://www.surveymonkey.com/results/SM-CYNZ9TJZL/, including both aggregate responses for each question, as well as each respondent's individual response in full. This is useful for tying specific comments or support requests back to the survey respondent for follow up.

There were 96 submissions, with 24 duplicate responses for a total of 72 unique responses. Duplicate responses were typically created by a contact examining the survey before completing at a later date, or revising a completed survey. Duplicate responses were deleted from the results.

2 Summary of Respondents

Of the 72 unique submissions, 19 were partially completed. A large majority are from governmental agencies, commonly environmental, geographical or statistical. A number of multinational research or conservation organisations were also represented. A list of all submissions is provided here.

Organisation	Organisation Type	Locality
INPE	Government Space Agency	Brazil
Instituto Geografico Agustin Codazzi	Government Mapping	Colombia
CENTRE DE SUIVI ECOLOGIQUE (CSE DAKAR)	Government Environmental	Senegal
GODAN	Multinational Organisation	Global
Space Research Institute NAS Ukraine and SSA Ukraine	Government Space Research/Agency	Ukraine
Harare Institute of Technology	University	Zimbabwe
AGRHYMET REGIONAL CENTRE	Multinational Organisation	Niger
GODAN	Multinational Organisation	Global
NRCan	Government Natural Resources	Canada

Croatian Meteorological and Hydrological Service	Government Meteorological and Hydrological	Croatia
Mountain Research Initiative	Research Institute, University	Switzerland
Vulcan, Inc.	Private Company	America
UK Office for National Statistics	Government Statistics	UK
ZAMG	Government Meteorology and Geophysics	Austria
European Environment Agency	Multinational Environmental	Europe
GÉANT	Multinational Technology	Europe
Servicio Geográfico Militar	Military Geographical	Uruguay
Meteorological Service of Canada, Environment and Climate Change Canada	Government Meteorological and Environmental	Canada
New Zealand Ministry for the Environment	Government Environmental	New Zealand
Mauritius Meteorological Services	Government Meteorological	Mauritius
CSE	Government Environmental	Senegal
Planning Authority, Malta	Government Planning	Malta
CEDARE	Multinational Organisation	Arab region and Europe
IGAC	Government Geographical	Colombia
	Private Individual	
National Centre for Statistics & Information	Government Statistics Agency	Oman
National Agency for Meteorology and Environmental Monitoring of Mongolia	Government Meteorology and Environmental	Mongolia
National Observatory of Athens, Greek GEO Office	Government Research	Greece
Tel Aviv University	University	Israel
Federal Office for the Environment	Government Environmental	Switzerland
Department of Meteorology, Cyprus	Government Meteorological	Cyprus
Survey Department	Government Mapping	Nepal
National Remote Sensing Center of China	Government Remote Sensing	China
German Federal agency for cartography and geodesy	Government Mapping Agency	Germany
Statistics Netherlands	Government Statistics	Netherlands
Romanian Space Agency	Government Space Agency	Romania
CREAF	Research Organisation	Spain
European Commission	Multinational	Europe
Ministry of Environment of the Slovak Republic	Government Environmental	Slovak Republic

RCMRD	Multinational Mapping Centre	Kenya
Geoscience Australia	Government Research	Australia
INSTITUTO METEOROLOGICO NACIONAL	Government Meteorological	Costa Rica
Ministry of Environment, Energy and Climate Change	Government Environmental	Seychelles
AARSE & chouaib doukkali University	University	Morocco
Central African Republic	Government Environmental	Central African Republic
ISPRS	International Remote Sensing Organisation	International
Statistics Sweden	Government Statistics	Sweden
Romanian Space Agency	Government Space Agency	Romania
Istituto Nazionale di Geofisica e Vulcanologia	Government Geophysics and Volcanology	Italy
National Space Research and Development Agency	Government Space Agency	Nigeria
National Institute of Statistics, Ministry of Planning	Government Statistics	Cambodia
Finland, FMI	Government Meteorological	Finland
MEXT	Government Science and Technology	Japan
Department of Science and Technology (South Africa)	Government Science and Technology	South Africa
SANSA	Government Space Agency	South Africa
	Government Environmental	Italy
Ministry of Environment, Ecology and Forest	Government Environmental	Madagascar
INEGI	Government Statistics and Geography	Mexico
TUBITAK	Government Research	Turkey
SPACE AGENCY OF PERU - CONIDA	Government Space Agency	Peru
Ministry of Foreign Affairs of Brazil	Government Foreign Affairs	Brazil
Malaysian Meteorological Department	Government Meteorological	Malaysia
European Union Satellite Centre	Government Satellite Security	Europe
Center for Ecological-Noosphere Studies NAS RA	Research Organisation	Armenia
Vietnam National Space Center (VNSC)	Government Space Agency	Vietnam
Malaysian Meteorological Department	Government Meteorological	Malaysia
ONG Organisation pour l'Environnement et de la Développement Durable	Nongovernmental organization Environment and Sustainable development	Africa

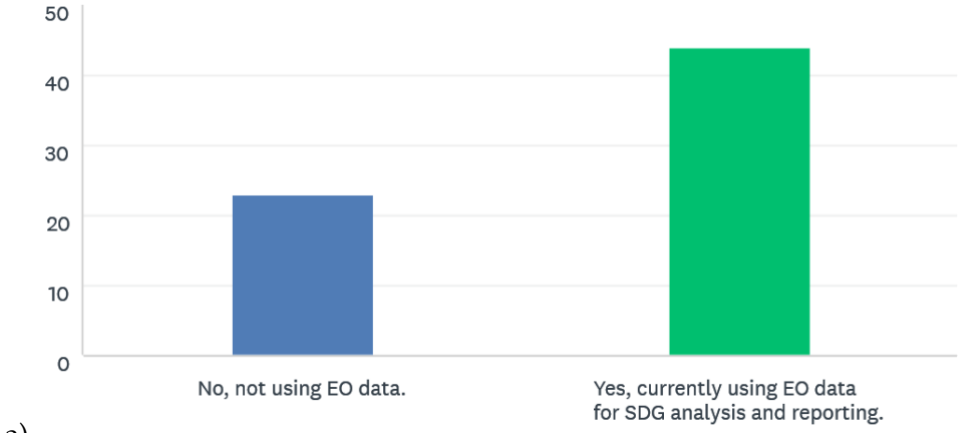
Table 1: Summary of respondents

3 Response Summaries

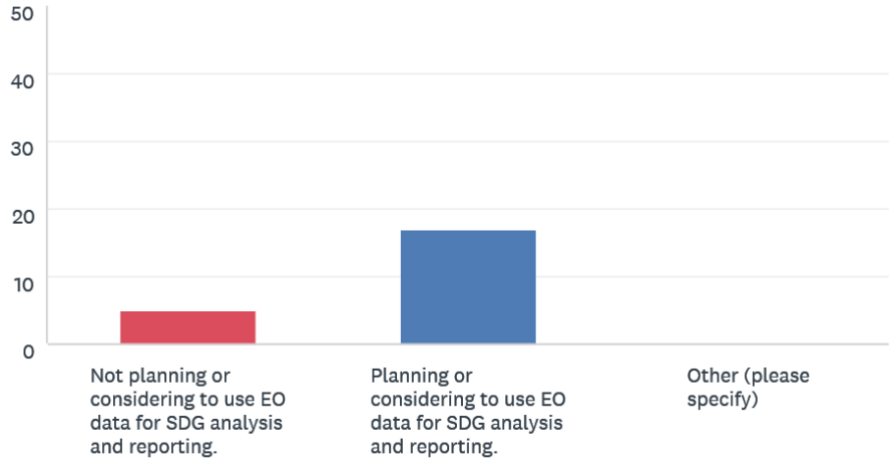
3.1 Use of EO Data

Current and Future Use

A majority of respondents (44/67) currently use EO data for SDG analysis and reporting, and of the remaining, a vast majority (17/22) are planning to use EO data in the future. Only 5 respondents indicated their country is neither currently nor planning or considering to use EO data for SDG analysis and reporting in the future (Figure 1b), and this is discussed in section 4.1.



a)



b)

Figure 1: Results of Q2 (a) and Q3 (b) on current and future usage of EO data for SDG analysis. Those not currently using EO data in a) are show in b), with 5 respondents in red not planning to use EO data for SDG reporting.

Type of Current and Future Use

– Countries are currently "using EO data for computing specific indicators, working with National Statistic Offices (NSO), and/or line ministries" (21/35) slightly more than they are "using EO data for national development plans or Voluntary National Reports (VNR)" (18/35) (Figure 2, blue). In five cases, countries were reported to perform both.

- On the planned or considered use of EO data, the following points are highlighted in comparing Q4 and Q5 noting that some respondents did not include current activities in their planned future activities, while some did. It was assumed that the current use of EO data in each country would be continued even if not explicitly stated.
  - 5 additional respondents answered they would use EO data for national development plans or VNRs to UN High Level Political Forum (HLPF).
  - 11 additional respondents indicated they were planning or considering the use of EO data for specific SDGs, working with NSO and/or line ministry.

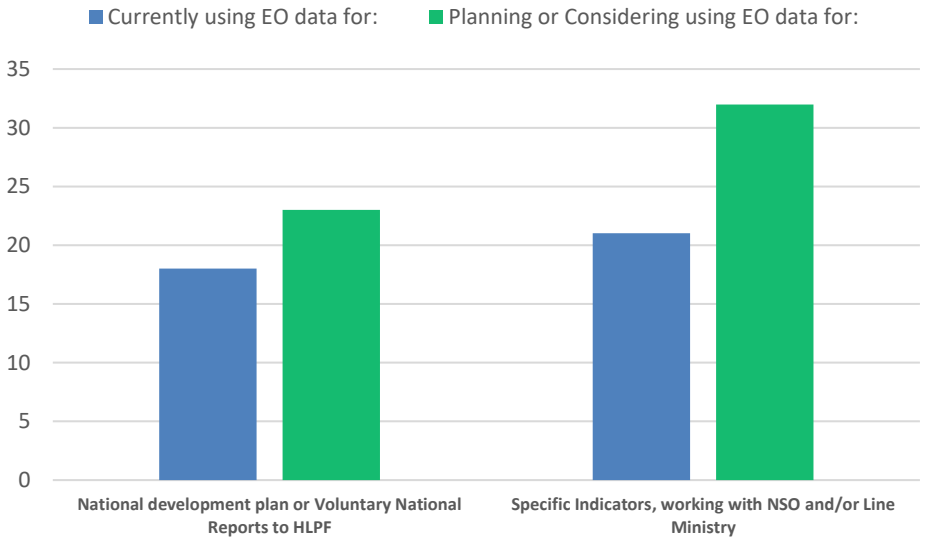


Figure 2: Comparison of results of Q4 "How is your country currently using EO data for SDG analysis and reporting?" (Blue) and Q5 "How is your organization planning or considering using EO for future SDG analysis and/or reporting?" (Green) showing the current and considered use of EO data for SDG analyses.

3.2 Data Types

Respondents were asked in questions 7, 8 and 9 to indicate which types of EO data they used for SDG analysis and reporting. Summaries of the responses are shown in Figures 3 to 5.

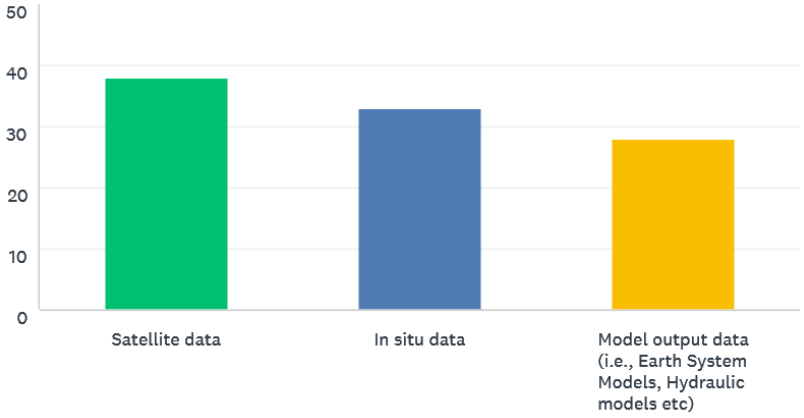


Figure 3: Result of Q7 "What types of EO data is your organization using for SDG analysis and/or reporting?"

Satellite Data

- 38 respondents indicated their country uses satellite data (Figure 3).

- Data products and processed data were the most selected, with 29 and 28 times respectively (Figure 4).
- Global datasets were commonly selected, at 25 times.
- Analysis Ready Data, Information products and Raw data were the three least selected options, but still used by over half of the respondents.
- Other responses in this category were not relevant replies (i.e. "None").

Figure 4: Result of Q8 "What type of satellite data is your organization using for SDG analysis and/or reporting?"

***In Situ* Data**

- 37 respondents indicated their country uses *in situ* data (Figure 3), and nearly all indicated they use National or local *in situ* data (Figure 5).
- Half of the respondents indicated they use Global or regional *in situ* data.
- Other responses in this category were:
  - *In situ* data (collected over the territory of Ukraine) are used for land cover development. Statistical data of crop yield, sowing areas are used. Meteorological data are used for biophysical modelling; and,
  - Outputs from Seasonal forecasting models.

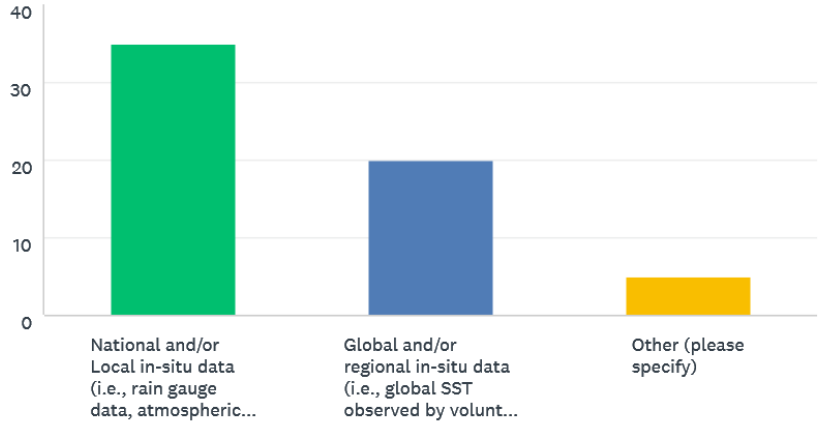


Figure 5: Result of Q9 "What type of in-situ data is your organization using for SDG analysis and/or reporting?"

Model Output Data

- 28 respondents indicated their country uses model output data.

3.3 Challenges

- Most challenges were selected by over a third of respondents, with the lowest selected challenge of Data cost selected by 27% of respondents. The most common challenge was Institutional coordination and bureaucracy, selected by 60%. Each challenge has been categorised as below, and it can be seen that each category has an even proportion of challenges (Figure 6).
- Organisational Issues: Coordination and bureaucracy (selected 30 times), Lack of understanding of EO data value (23), Compatibility with current method (15), Reluctance to change current method (15).
- Capacity Issues: EO data integration with statistical data (26), Lack of capacity to use EO data (26), Data Quality Assessment (18).
- Data Issues: Access (25 counts), finding data (24), Storage and Processing (23), Coverage (23), and Cost (13).
- Short answer "Other" responses include: Inadequate funding, lack of capacity building, access to statistical data at the right scale and financial constraints in set up and maintenance of ground receiving stations.

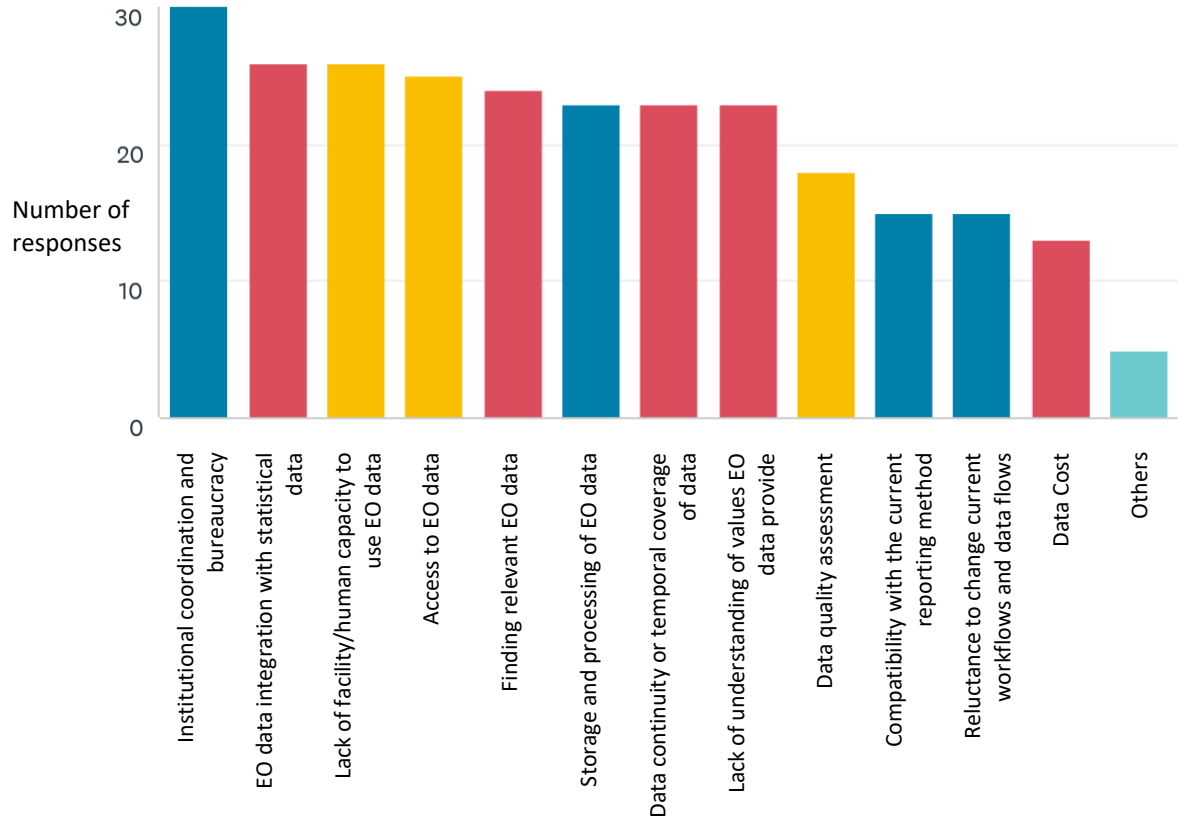


Figure 6: Responses to Q6 "What are major challenges to your country in using EO data for SDG analysis and reporting? (Please select all that are appropriate)". Answers are coloured according to their above category.

4 Discussion

4.1 Non-users of EO Data for SDG Analysis

Five respondents indicated they did not use EO data for SDG analyses and were not planning or considering doing so. Of these, two respondents were found to be from organisations that were not expected to use EO data for SDG analysis, and two respondents only submitted partial responses.

The remaining response indicated in later questions they use Satellite data, *in situ* data, and Model Output data for SDG analysis and/or reporting, so it is likely their country does use EO data for SDG analysis. Their response identified the challenges being entirely data related: Finding relevant EO data, Access to EO data, Storage and processing of EO data, Data quality assessment, Data continuity or temporal coverage of data, and Data cost.

4.2 Overview of the Use of EO for SDG Analysis

A majority of respondents are currently using EO data, and of those that are not, most intend to begin using EO data for SDG analysis. Overviews of how these data are being used is provided below.

Open Responses on Specific EO Data Use

There were 49 comments on the current or future use of EO data, ranging from simple summaries to detailed and informative plans. The full text is available in the appendix, and an overview is provided below.

SDG 15 was the most commonly addressed goal, with high interest in indicators 15.1.1 (Forest area (as a percentage of total land area)) and 15.3.1 (Proportion of land that is degraded over total land area).

Current use of EO Data for SDG Analysis

For question 4, nineteen respondents provided comment on examples of their use of EO data for calculating specific SDG indicators. These have been summarised by indicator, in the aim to indicate the various methods of calculating each indicator. Responses that do not include a specific indicator or EO data source are grouped following the below specific examples.

Q4. How is your country currently using EO data for SDG analysis and reporting?

2.4.1:

– Space Research Institute NAS Ukraine and SSA Ukraine are using Sentinel 1, Sentinel 2 and Landsat 8 data.

3.9.1:

– The UK Office for National Statistics calculates the mortality rate attributed to household and ambient air pollution. Both using modelled concentrations and are calculated on a 1km x 1km grid using a dispersion model using measurements taken from Defra's Automatic Urban and Rural network.

6.4.2:

– Statistics Canada calculates 6.4.2 Level of Water Stress: Freshwater withdrawal as a proportion of available freshwater resources.

9.1.1:

– UK Office for National Statistics calculates indicator 9.1.1 using the GRIP (Global Roads Inventory Project) dataset for the roads and the Global Human Settlement Layer (GHSL) for the population count and urban/rural split.

11.3.1:

– SANSA use SPOT 5 and Landsat 5 to map and assess land consumption of selected big and small cities in South Africa, for calculation of 11.3.1 Ratio of Land Consumption Rate to Population Growth Rate.

– Statistics Canada uses land cover data integrated with socio-economic data.

11.6.2:

– The UK Office for National Statistics calculates indicator 11.6.2: Annual mean levels of fine particulate matter (PM2.5 and PM10) in towns and cities (population weighted) using the same modelled concentrations as for 3.9.1.

11.7.1:

– German Federal agency for cartography and geodesy calculates 11.7.1, built up area and open space; using data from the German land cover model, imperviousness-HRL, and Sentinel 2.

13.1:

– Mauritius Meterological Services uses Satellite and ground observations for 13.1.1-13.1.3, analysis for weather forecast and issuance of Early Warnings.

15.1.1:

– Space Research Institute NAS Ukraine and SSA Ukraine calculates 15.1.1 using Sentinel 1, Sentinel 2 and Landsat 8 data.

– The German Federal Agency for Cartography und Geodesy are working together with the German National Statistics Office to calculate 15.1.1: forest area and land area; Land cover/Land use data from the German Land cover model.

– New Zealand Ministry for the Environment calculates 15.1.1 with national land use and land cover mapping from Sentinel 2 data.

15.3.1:

– Space Research Institute NAS Ukraine and SSA Ukraine calculates 15.3.1 using Sentinel 1, Sentinel 2 and Landsat 8 data.

– AGRHYMET Regional Centre noted they have a mandate to help ECOWAS countries with SDG analysis, particularly with 15.3.1.

– CSE Dakar assesses 15.3.1, land cover and land degradation at various sites.

15.4.2:

– New Zealand Ministry for the Environment calculates 15.4.2 with land cover mapping from Sentinel-2 data in conjunction with elevation data.

– German Federal agency for cartography and geodesy calculates 15.4.2 using data from the German Terrain model and the German Land model.

Other free responses to Q4:

– IGAC are using Landsat, Sentinel and other optical and radar data to compute almost all national SDG indicators.

- ONG Organisation pour l'Environnement et de la Développement Durable calculates indices such as NDVI, Land Degradation Index, Human Development Index, Population Growth Rate, Number of Recipients of Land Reclamation Projects, % of Arid Lands, % of Cropland, and others.
- Ministry of Environment, Energy and Climate Change use EO to calculate most indicators under SDGs 6, 7, 9, 13, 14, 15.
- Eliot Christian is leading a world-wide initiative to establish a "Global-Scale Alert Hub for Official Emergency Alerts" (see http://alert-hub.org), relevant for targets 11.5 and 13.3. In SDG 3 and SDG 4, this is relevant for targets 3.d and 4.a.
- The UN Global Platform in development with ONS is supporting the analysis of satellite imagery and the development of algorithms and methodologies for SDGs. Including research into producing some of these automatically, using the Earth Observation, Methods Library and Machine Learning services within the Platform.
- Istituto Nazionale di Geofisica e Vulcanologia use Geophysical and Geochemical data for geo-hazard assessment, including seismic and volcanic hazard, tsunami hazard and anthropogenic hazards.
- Tel Aviv University retrieves soil spectral information from local national and global levels.
- ZAMG calculates the following;
  - SDG 2, 2.3.1: crop monitoring, land use, drought monitoring, soil moisture. SDG 6, 6.3.2;
  - SDG 11, e.g. 11.3.1, 11.3.2 urban planning etc;
  - SDG 13, 13.1.1;
  - SDG 15, 15.1.1;
  - Plus a number of indicators based on https://sustainabledevelopment.un.org/content/documents/11803Official-List-of-Proposed-SDG-Indicators.pdf.

Future or Considered Use of EO Data for SDG Analysis

Q5 How is your organization planning or considering using EO for future SDG analysis and/or reporting?

2.4.1

- Space Research Institute NAS Ukraine and SSA Ukraine developed informational technologies for monitoring indicators 2.4.1 (Proportion of agricultural area under productive and sustainable agriculture).

6.6.1

- Statistics Canada is planning to use the Global Water data set (inter alia) to measure 6.6.1. “Changes in extent on water-related ecosystems over time”, for example.
- The Center for Ecological-Noosphere Studies NAS RA aims to protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes

by 2020, relevant to indicator 6.6.1 Percentage of change in the extent of water-related ecosystem.

- SANSA will use satellite imagery to map and assess extent of water bodies.
- German Federal Agency for Cartography und Geodesy will use map the extent of water bodies from sentinel-1/-2/-3.

11.1.1

- SANSA will use satellite imagery, human settlement and statistical data to quantify people living in informal settlements.

11.2.1

- SANSA will use satellite imagery and human settlement data, digital surface models, road network and statistical data to assess access to public transport.

11.5

- Eliot Christian notes the Global-Scale Alert Hub for Official Emergency Alerts uses EO data in the context of 11.5. Specifically, EO data is used for hazard threats such as: floods, typhoons, tsunami, earthquakes, landslides, and avalanches, among many others. He also notes that the dissemination of these emergency alerts leverages the satellite direct broadcast capability established through GEO.

11.7.1

- SANSA will use satellite imagery and products and non-spatial data to map and assess access to public open space.

15.1.2

- The UK Office for National Statistics is planning on using satellite imagery (Sentinel and/or Landsat) to classify and compute forest area. The EO data source(s) have not been decided upon yet, as they are still investigating the extent to which they want to incorporate a time series element into the reporting.

15.3.1

- The Center for Ecological-Noosphere Studies NAS RA aims by 2030 to combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world.
- The AGRHYMET Regional Centre aims to continue monitoring land degradation analysis and estimate carbon sequestration in ECOWAS countries.
- CSE DAKAR are planning to use satellite land cover data to monitor land cover change for land degradation analysis.
- The Ministry of Environment, Ecology and Forest use Satellite land cover data to monitor land cover change for land degradation analysis. They also use satellite data to monitor disasters (drought, flood, earthquake, cyclones), sea level, maritime piracy, state of the environment, bush fires, etc.
- The German Federal agency for cartography and geodesy will investigate degraded land and Corine Land Cover using Copernicus data. Research regarding other possible indicators is being conducted.

- The New Zealand Ministry for the Environment notes research into detecting changes in bare earth % in grazing context in optical satellite imagery will help monitor land degradation. They are also considering erosion scar detection from LiDAR.
- The National Agency for Meteorology and Environmental Monitoring of Mongolia indicated they are planning to use satellite land cover data to monitor land cover change for land degradation analysis.
- Space Research Institute NAS Ukraine and SSA Ukraine report for 15.3.1 and 15.1.1, national landcover maps created with Sentinel-1/2 and Landsat-8 data are utilized with the use of machine learning data.
- VNSC are working on 15.3.1.

15.4

- The Center for Ecological-Noosphere Studies NAS RA aims by 2030 to ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development.
- The UK Office for National Statistics plans to map spatial extent of mountain biodiversity using a Digital Terrain Model at 5 metre resolution and a Digital Surface Model at 2 metre resolution.

Other Selected Free Responses to Q5

A number of respondents indicated they would pursue improvements to existing analyses in the future, or that they are currently considering the best use of EO data for SDG analyses. The full text of these responses is available in the appendix. The responses listed below indicate EO data use for SDG analyses, but do not specify individual indicators.

- IGAC are planning to use satellite land cover data to monitor land cover change for land degradation analysis, deforestation, land administration, monitoring crops, prevention of disasters, topographic, soils and cadastre map production.
- Statistics Sweden is about to setup the national coordination for monitoring of global and national indicators, likely to find EO data useful for indicators monitoring the planet.

4.3 Notable Comments and Resources

Respondents were asked to provide comments/lessons learned with regard to the use of EO data for SDGs, as well as any good practice or project documentation. 21 comments and 14 good practice or project documentation were received. Complete responses are included in the appendix, and a brief summary of notable comments and resources are provided here.

Comments or Lessons Learned

Data

- It is important to access EO data and cloud computing more freely and easily. There is still a great need for cost effective satellite data of high spatial resolution to generate the indicators at the local scale. Too much time is wasted on data pre-processing.
- There are issues doing time series analysis over periods of months or years due the vast volumes of data generated.
- EO data for post disaster recovery is very useful for proper mobilisation of resources. Availability of such data is most desirable.

Institutional

- The Central African Republic has to learn about the evolution of the Earth and consequently take action aiming to face any eventuality.
- In the UK there appears to a lack of a centralised location/resource for EO data.
- There is an opportunity to promote the use of EO data in line ministries than only supporting reporting of SDGs.
- Work flows for SDGs should be tested, validated and cross checked for consistency and comparability. Local processing and analysis/interpretation is important to ensure national circumstances are taken into consideration.
- There is potential to do more, but that means modifying work flows and expected outputs, and that needs to come from the top. There are challenges when convincing agencies and reporting institutions to use EO data for the SDGs, as there is lack of awareness on the benefits/importance of using EO data for reporting SDGs, and it proves hard to find concrete projects. It is important to further integrate institutions and bureaucracy at all levels in order to better systematize policies and goals, quantify data and devise applications for achieving SDGs.

Capacity

- There is a need to build capacity of ECOWAS countries to better use EO.
- Important for NSO to team up with experts in remote sensing.

Good Practice and Project Documentation

Data and Projects

- Case study on Deqing of China which has been introduced in 15th plenary at SDG panel.
- www.g4aw.nl
- The Global-Scale Alert Hub for Official Emergency Alerts is described, and its prototype is accessed, at http://alert-hub.org.
- ONS' Data Science Campus have recently reported on their use of Google Street View (https://datasciencecampus.ons.gov.uk/mapping-the-urban-forest-at-street-level/) to calculate the density of trees and vegetation across the road network of all 112 major towns and cities in England and Wales. There is also a GitHub page (https://datasciencecampus.github.io/street-view-image-processing/) with further details of the image processing pipeline and associated code used.
- ONS' Data Science Campus are also currently working on methods using aerial photography to calculate how 'green' residential gardens are. This work is still in development, however, like the previously mentioned project, documentation will be publicly released when ready. Again, while this work is not being done specifically for the SDGs, the methods and best practice developed during this project could be adapted for different purposes.
- ONS would also be happy to share documentation following the research done on a global 9.1.1 indicator. That project highlighted a wider weakness in current EO data to address SDG indicators. Currently it could be argued EO data is part of a solution looking for a problem, when in fact the SDG agenda provides an excellent opportunity for EO data to address data gaps. For example, we would be happy to share our documentation where we suggest potentially applications for EO data to focus on. In

the case of Indicator 9.1.1 this could mean using EO data to identify road material (i.e. tarmac, mud, gravel etc.).

- UN Global Platform publishes algorithms and methodologies within the Methods Service, https://methods.officialstatistics.org.
- Brazil has developed several open and free softwares used in EO and data sharing.
- (Translated) Land cover dynamics, socio-economic and biophysical baseline situation data by Collect Earth Open Foris at the level of some rural and national communes.
- Space Research Institute NAS Ukraine and SSA Ukraine developed several workflows for SDG indicators calculation within ERA-PLANET project - 2.4.1, 15.1.1 and 15.3.1.
- SERVIR Global (USAID/NASA) planning service process.
- Integration of Satellite EO data with official statistics to generate SDG 11.3.1 Ratio of land consumption rate to population growth rate https://www150.statcan.gc.ca/n1/pub/16-201-x/16-201-x2016000-eng.htm.
- Integration of in-situ EO data with official statistics to generate SDG 6.4.2 Level of Water Stress: Freshwater withdrawal as a proportion of available freshwater resources https://www150.statcan.gc.ca/n1/pub/16-201-x/16-201-x2017000-eng.htm.
- For example, analysis and spatial modelling for the generation of agroclimatic risk maps due to floods (Scale 1: 25,000) and drought at scale 1: 100,000 in the Magdalena River Basin.
- Vietnam Data Cube.

Capacity Support

- A new collaboration between GEO and Amazon Web Services (AWS) offers developing countries access to cloud services.
- The Swiss Data Cube team has recently received a grant to support Armenian colleagues from the Center for Ecological-Noosphere Studies (CENS) and the Institute for Informatics and Automation Problems (IIAP) of the National Academy of Sciences in developing the first version of an Armenian Data Cube. The project is entitled "ADC4SD: Armenian Data Cube for Sustainable Development".
- The UN Global Platform GWG has published the draft UN handbook on using satellite imagery for statistics, https://unstats.un.org/bigdata/taskteams/satellite/UNGWG_Satellite_Task_Team_Report_WhiteCover.pdf.

Organisations and Reporting

- The results of developments by Space Research Institute NAS Ukraine and SSA Ukraine are used for UNEP [http://web.unep.org] reporting. In particular results on Land Degradation Neutrality are provided to UNCCD [https://www.unccd.int]. NEXUS approach technologies are developed within GEO-ESSENTIAL ERA-PLANET project. Ministry of ecology of Ukraine with support of FAO and World Bank currently works of open environment system intended for SDG monitoring [https://menr.gov.ua/news/32130.html].

4.4 Specific Requests or Recommendations from Respondents

Respondents were asked to outline any specific support that they would like to receive from EO4SDG or GEO to support the integration of EO into their SDG processes. Many respondents had either general needs for capacity building and data access, or specific areas requiring assistance. Detailed cases are provided below, and the full list of responses is provided in the appendix.

- Respondents from the German Federal agency for cartography and geodesy suggested the following:
  - Writing the methodology for the Tier II/III indicators with more specific Copernicus sensors in mind and/or with two or more suggested methods using different Copernicus sensors, in order to have a harmonised global implementation;
  - It would be very helpful if GEO/EO4SDG could provide a daily or weekly list of reports and articles that have been published by them or other SDG related projects;
  - We suggest that GEO attempts to harmonise the various global best practice reports into a collection of best practice reports that can be accessed and shared by all; and,
  - We suggest more communication between the EO4SDG and the EuroGEOSS action groups to collaborate efforts and omit redundancies.
- The respondent from GODAN would like a process that turns around the questions from EO to reporting on SDG's to how EO data is used to achieve the goals of the SDGs. GEO and EO4SDG could make an impact on how for example EO data are delivered to society to make a maximum impact by those who integrate EO data into applications (decision support tools, policy assessment tools, scenario applications, market information, financial applications etc., accountability tools for value chains).
- The response from the UK Office for National Statistics was highly detailed and included a summary as follows:
  - ONS has thus far only used limited amounts of EO data for SDG analysis and reporting, however we have experience using EO data for non-SDG focused applications and are happy to share our experiences;
  - There is a desire to increase the amounts of EO data used by ONS to report on SDGs, but there are technological and methodological challenges that will need addressing before this can be done more frequently;
  - There are opportunities for EO data to focus on filling known data gaps in SDG reporting. However, while having access to these data are an important aspect of this, having detailed guidance on how to handle and process the data (for different levels of geospatial expertise) also needs to be considered an essential part of the process;
  - The UK lacks a centralised authoritative resource for EO data (in terms of data availability, what research is/was being undertaken and methods/best practice). We highlighted this in our response to the UK's newly established Geospatial Commission's 'Call for Evidence' in November 2018 and would welcome any

efforts made to provide such a function nationally (or internationally) by an authoritative body;

- ONS is currently leading the development of United Nations Global Platform. https://unstats.un.org/bigdata/taskteams/globalplatform/;
- There are various task teams developing algorithms, methodologies and training for using big data to create official statistics, including development of SDGs;
- The Task Team on Satellite Imagery and Geo-Spatial Data aims to provide strategic vision, direction and development of a global work plan on utilising satellite imagery and geo-spatial data for official statistics and SDG indicators;
- The satellite task team has released a draft handbook on creating official statistics using satellite imagery, available here. https://unstats.un.org/bigdata/taskteams/satellite/UNGWG_Satellite_Task_Team_Report_WhiteCover.pdf;
- The UN Global Platform is currently in talks with Planet and AirBus to provide satellite imagery for the UN Global Platform until 2030 to support the SDGs;
- We have deployed an Earth Observation service within the UN Global Platform to support analysis of satellite imagery. Along with a location analytics service for analysing location based data, such as AIS, ADS-B and mobile phone data;
- The UN Global Platform is available to all National Statistical Offices (NSOs) and their partners; and,
- Please note, the inputs provided in this survey are not an exhaustive list of contributions ONS could make to helping shape where EO4SDG and GEO should focus to support the use of EO for SDGs. Please feel free to contact us directly if you would like to discuss anything further.

- The National Observatory of Athens, Greek GEO Office respondent would like to see:
  - A presentation toolkit of workflows between EVs and SDG indicators, with concrete examples and their application in other countries, probably with testimonies on cost, time, resources savings;
  - Regular updates on progress;
  - A universal platform to facilitate the use of EO for SDG monitoring;
  - A library of workflows ready to replicate;
  - Workshops at the national level to further boost local collaborations; and,
  - A dedicated forum between countries to exchange best practices and know how on technical issues.
- The respondent from the Meteorological Service of Canada, Environment and Climate Change Canada noted; at the Ministerial Summit in 2019, it would be interesting to have countries showcasing specific success stories of indicators and targets measured with EO data, the same way Geoscience Australia has given briefings on how they built the business case for data infrastructure at the Washington Plenary. It is necessary to show the results and then to explain how to make it happen.

Summary Observations

The GEO Principal survey: Member Country uses of Earth observations for the SDGs survey was well responded to with over 70 responses from a very wide range of countries and agencies. Valuable information on the number of agencies currently or planning on using EO data in SDG analyses was gained, as well insights on the types of EO data used, be it satellite, in-situ or model data. Finally, a large number of comments, recommendations and resources were collected, with abundant opportunity for follow up investigation.

Acknowledgements

Very valuable contribution by GEO Principals and other respondents to the survey is highly appreciated.

This survey was planned by GEO EO4SDG Initiative and conducted by JAXA and Symbios in close cooperation with the GEO Secretariat.

Appendix

A table containing long response answers is provided for reference. A second table showing responses to "Other" options to multiple response questions is provided below. Finally, a list of questions asked to respondents is provided. Please note that the survey automatically directed respondents to the appropriate question as marked by "Please respond to Q3", etc.

Organization	Do you have any other comments/lessons learned with regard to use of EO data for SDGs?	Do you have any good practice or project documentation that you are willing and able to share?	Please outline any specific support that you would like to receive from EO4SDG or GEO to support the integration of EO into your SDG processes.
Instituto Geografico Agustin Codazzi		yes, we have	Financial and scientific support.
CENTRE DE SUIVI ECOLOGIQUE (CSE DAKAR)			Development of methods for operationalization and repeatability.
Space Research Institute NAS Ukraine and SSA Ukraine	The results of our development are used for UNEP [http://web.unep.org] reporting. In particular results on Land Degradation Neutrality are provided to UNCCD [https://www.unccd.int]. NEXUS approach technologies are developed within GEO-ESSENTIAL ERA-PLANET project. Ministry of ecology of Ukraine with support of FAO and World Bank currently works of open environment system intended for SDG monitoring [https://menr.gov.ua/news/32130.html]	We developed several workflows for SDG indicators calculation within ERA-PLANET project - 2.4.1, 15.1.1 and 15.3.1	Support to move Ukraine to European caucus for better collaboration with our European partners
Harare Institute of Technology	non		GHG Training and capacity to determine GHG sources in the country by use of EO
AGRHYMET REGIONAL CENTRE	There is a need to build capacity of ECOWAS countries to better use the EO	SERVIR Global (USAID/NASA) planning service process	Capacity building to jump from satellite data to services related to SDG monitoring

GODAN	EO is very broad and SDGs cover a huge field, therefore the questions in this survey can all be ticked for the NL's.	Www.g4aw.nl	I would like a process that turns around the questions from EO to reporting on SDG's to how EO data is used to achieve the goals of the SDGs. GEO and EO4SDG could make an impact on how for example EO data are delivered to society to make a maximum impact by those who integrate EO data into applications (decision support tools, policy assessment tools, scenario applications, market information, financial applications etc., accountability tools for value chains)
ZAMG	Such survey is a first step to raise the awareness on a central level. The answer was given to the best of our information, especially on EU level with Copernicus Services there are a lot of activities the private sector is involved, to get an overarching overview is still an effort.	Not at the moment, it needs some more investigation.	EO4SDG supports with a good overview, a more interaction not only on scientific contribution but also try to describe the whole process and value chain of products, services and how its useful for decision making on national level best practice show cases.
GÉANT			If you could provide outline material for how SDG monitoring could benefit a participating organisation, this would help to change people's minds.
Meteorological Service of Canada, Environment and Climate Change Canada	There is certainly potential to do more, but that means modifying work flows and expected outputs, and that needs to come from the top.	This is an example of work where we integrated Satellite EO data with official statistics to generate SDG 11.3.1 Ratio of land consumption rate to population growth rate https://www150.statcan.gc.ca/n1/pub/16-201-x/16-201-x2016000-eng.htm And this is an example where we integrated in-situ EO data with official statistics to generate SDG 6.4.2 Level of Water Stress: Freshwater withdrawal as a proportion of available freshwater resources https://www150.statcan.gc.ca/n1/pub/16-201-x/16-201-x2017000-eng.htm	Funding is always appreciated and helpful, if available. At the Ministerial Summit in 2019, it would be interesting to have countries showcasing specific success stories of indicators and targets measured with EO data, the same way Geoscience Australia has given briefings on how they built the business case for data infrastructure at the Washington Plenary. It is necessary to show the results and then to explain how to make it happen.

New Zealand Ministry for the Environment	Local processing and analysis/interpretation is important to ensure national circumstances are taken into consideration e.g. plantation forest harvesting is not forest loss but sustainable harvest which is replanted within 1-3 years. Global statistics tend to miss this.		None I can think of at present. Maybe case studies of the use of EO for SDG reporting in other countries would be helpful to spark ideas of how we could use EO more effectively.
CSE			capacities building on data process
German Federal Agency for Cartography und Geodesy	1. We have observed challenges when convincing agencies and reporting institutions to use EO data for the SDGs. 2. Access to high resolution data is limited due to costs. 3. We recommend writing the methodology for the Tier II/III indicators with more specific Copernicus sensors in mind and/or with two or more suggested methods using different Copernicus sensors, in order to have a harmonised global implementation.	We are open to the idea and this is currently being discussed.	1. It would be very helpful if GEO/EO4SDG could provide a daily or weekly list of reports and articles that have been published by them or other SDG related projects 2. We suggest that GEO attempts to harmonise the various global best practice reports into a collection of best practice reports that can be accessed and shared by all. 3. We suggest more communication between the EO4SDG and the EuroGEOSS action groups to collaborate efforts and omit redundancies.
IGAC	There is still a great need for satellite data of high spatial resolution to generate the indicators at the local scale	Yes. For example, analysis and spatial modelling for the generation of agroclimatic risk maps due to floods (Scale 1: 25,000) and drought at scale 1: 100,000 in the Magdalena River Basin	Support national events with participation experts and researchers
	GEO made a recent announcement that will greatly facilitate the broadening of standards-based emergency alerting to developing countries. This is the new collaboration between GEO and Amazon Web Services (AWS) that offers developing countries access to cloud services to help with the hosting, processing and analysis of big data about the Earth. Through this offer, any developing country can have a simple, customized, and powerful emergency alerting tool that greatly augments their early warning capabilities.	The Global-Scale Alert Hub for Official Emergency Alerts is described, and its prototype is accessed, at http://alert-hub.org.	EO4SDG and GEO can help promote the implementation of the CAP (Common Alerting Protocol) international standard, which is key to the vision of enhanced early warning,

National Observatory of Athens, Greek GEO Office	There is willingness from the NSO to collaborate with the GEO focal point. The operation of the Greek GEO Office (GGO) and the fact that it is being hosted by a public Research Center of high integrity like the National Observatory of Athens, seems to be catalytic. It is mostly bureaucracy, but also maturation of the idea on behalf of the NSO, that will probably result to delay of operations. Best practices: - GGO collaborates with EO4SDG to receive relevant material and coordinate actions at the national level - GGO has presented the benefits of using EO for SDG reporting at the NSO premises, to relevant department heads - GGO has participated in a Eurostat conference in Greece (Smart Statistics for Smart Cities), co-organized by the NSO as well, to demonstrate at the higher level the opportunities from exploiting EO for supporting the SDG frame - iBEC has organized a high level conference (Greek ministries, GEO Director), to identify and set up a regional (Balkan) network that will have a key role in the engagement and collaboration with user stakeholders that would significantly benefit from using EO to ensure the implementation and monitoring of SDGs - GGO in a coordinating role, through the participation of Greek partners in relevant projects (e.g. SMURBS/ER-PLANET, GEO-ESSENTIAL/ERA-PLANET) already builds the EO community to support the relevant activities to support NSO in reporting.	All that have already been mentioned in the previous question	- A presentation toolkit of workflows between EVs and SDG indicators, with concrete examples and their application in other countries, probably with testimonies on cost, time, resources savings - Regular updates on progress - A universal platform to facilitate the use of EO for SDG monitoring - A library of workflows ready to replicate - Workshops at the national level to further boost local collaborations - A dedicated forum between countries to exchange best practices and know how on technical issues
Tel Aviv Univeristy	not at the moment	standard and protocol to generated soil spectral libraries	provide the know how to generate soil spectral archive and to use it for practical applications
Survey Department	There is lack of awareness on the benefits/importance of using EO data for reporting SDGs and currently the Department is trying to convince about it		Capacity Development

National Remote Sensing Center of China	1. Too much time are wasted on data pre-processing; 2. It is important to access the EO data more freely and easily; 3. More free and open environment of cloud computing is necessary.	Case study on Deqing of China which has been introduced in 15th plenary at SDG panel.	Efforts should be done not only on data sharing and easily used, but should also on getting people (especially the government of each country) know the importance between the EO data and SDG goals realization.
Statistics Netherlands	My experience, both national and international, is that a lot of people see the potential of using EO for SDG's, but it proves hard to find concrete projects.		
INSTITUTO METEOROLOGICO NACIONAL			It's very important the capacitation in the use of the data EO, the other information sources.
Ministry of Environment, Energy and Climate Change			Capacity Building and access to more EO datasets
Central African Republic	Located in the heart of the African continent and straddling the Congo Basin and the Chad Basin, the Central African Republic has to learn about the evolution of the Earth and consequently takes action aiming facing any eventuality. By way of illustration we can highlight the use of information relating to weather disturbances which makes it possible to define the periodicity of agricultural activities in different parts of the country.	yes	The Central African Republic needs 2 kinds of support from GEO. The first and critical one is to have access to EO data. The second is to build the capacity of, let's say 2 people, in the use of EO data.
Statistics Sweden	Important for NSO to team up with experts in remote sensing, the reporting will be shared among a number of gov agencies but NSO need to have certain knowledge.	National indicator on access to public green space.	Collaboration established on national level with the Swedish Copernicus cooperation team.
National Institute of Statistics, Ministry of Planning	No.		Need GEO expert.

SANSA	There is an opportunity to promote the use of eo data in line ministries than only supporting reporting of SDGs	Yes	
Pirrone	Work flows for SDGs should be tested, validated and cross checked for consistency and comparability	We are working on but not yet ready for sharing.	We are working with ministry of Environment, as soon as key questions will come up we will contact GEO Sec for support
Ministry of Environment, Ecology and Forest	We have to implement the using the EO data for SDGs		I would like to receive from EO4SDG or GEO to support to support the integration of EO into your SDG processes
INEGI			Reluctance to change current workflows Data quality assessment
SPACE AGENCY OF PERU - CONIDA			Training for specialists and people who work with the data
Ministry of Foreign Affairs of Brazil	It is important to further integrate institutions and bureaucracy at all levels in order to better systematize policies and goals, quantify data and devise applications for achieving SDGs.	Brazil has developed several open and free software's used in EO and data sharing.	Brazil is working to improve the integration of institutions and bureaucracy in order to better use EO into national SDG processes. Specific needs are in the process of being identified and any support required may be asked in the future.
Malaysian Meteorological Department			Expert guidance in the production of SDG indicators.

Center for Ecological-Noosphere Studies NAS RA	The successful implementation of SDGs in Armenia requires innovative approaches, internationally established methodologies and standards to complement the data gaps and to reinforce the technical capacities. For Earth observation applications, work needs to be done on data and skills-related (capacity building) and communication related issues. To reach synergy at a higher level, issues such as standardization, interoperability, harmonization, multiple use of data, operating massive volumes of data, setting up and maintaining in-situ networks and citizens' observatories all need attention. Finally, strong and in-depth Government – research organizations synergy should be foreseen. Government policy should be based and aligned with technical assistance and capacities the research organizations provide.	The Swiss Data Cube team has recently received a grant to support Armenian colleagues from the Center for Ecological-Noosphere Studies (CENS) and the Institute for Informatics and Automation Problems (IIAP) of the National Academy of Sciences in developing the first version of an Armenian Data Cube. The project is entitled "ADC4SD: Armenian Data Cube for Sustainable Development". The main objective of ADC4SD will be to transfer the necessary knowledge from Switzerland to Armenia for developing and implementing the first version of an Armenian Data Cube (ADC) with a complete and up-to-date archive of Earth Observations data (e.g., Landsat, Sentinel-1&2), benefiting from University of Geneva & GRID experience in implementing the Swiss Data Cube. Synergies will be created between leading research teams in both countries empowering Armenian scientists to benefit from EO data by lowering the barriers caused by Big Data challenges and providing access to spatio-temporal data over the entire Armenia. Ultimately, the ACD4SD project will deliver a unique capability to track changes in unprecedented detail using EO data, enabling more effective responses to problems of national significance.	In 2016, Armenia has initiated the Sustainable Development Goals (SDG) nationalization process and encounters various problems caused by the lack of sufficient data impeding efficient national environmental monitoring. Alternative means need to be developed to fill this gap. Therefore, Earth Observation Data Cubes (EODC) represent a promising solution for continuous remote environmental monitoring in Armenia. However, technical capacities of Armenian institutions need to be improved to benefit from the new possibilities offered by EODC. The Swiss Data Cube team will support to achieve ADC4SD main goal - to transfer the necessary knowledge from Switzerland to Armenia for developing and implementing the first version of an Armenian Data Cube (ADC) with a complete and up-to-date archive of Earth Observations data (e.g., Landsat, Sentinel-1&2), benefiting from University of Geneva & GRID experience in implementing the Swiss Data Cube.
Vietnam National Space Center (VNSC)		Vietnam Data Cube	Satellite data; data analysis and capacity building

ONG Organisation pour l'Environnement et de la Développement Durable		Dynamiques d'occupation des terres, Données de situation de référence socio-économique et biophysique par Collect Earth Open Foris au niveau de quelques communes rurales et nationale (Land cover dynamics, socio-economic and biophysical baseline data by Collect Earth Open Foris at the level of some rural and national communes)	Images satellite récentes et haute résolution, données relative au changement climatique au Sahel et au Niger, données relatives aux surfaces forestières, et au carbone séquestrés, données relatives aux populations impactées par les pollutions etc... (Recent satellite images and high resolution, data on climate change in the Sahel and Niger, data on forested surfaces, and carbon sequestered, data on populations impacted by pollution etc.)

UK Office for National Statistics	In the UK there appears to a lack of a centralised location/resource for EO data. Considering EO data encompasses more than just satellite data, the lack of an authoritative resource (or if one does exist, being able to distinguish it from other offerings) hampers any efforts as it makes any form of coordination difficult (both across organisations and datasets). We highlighted this as an issue in ONS' response to the UK's newly established Geospatial Commission's 'Call for Evidence' and would hope they are in a position to help with this, although that is unlikely to help in the short term (12 to 18 months). Another issue we identified is the temporal element of the data. There are issues doing time series analysis over periods of months or years due the vast volumes of data generated. While the issues involved are complex, in general they can be considered technological (i.e. how best to handle and store the data) or methodological (i.e. how do you reconcile any differences caused by data being captured at different times of year and day). The work we did on Indicator 9.1.1 shows EO data forming part of the creation of 'traditional' geospatial datasets. The positive element is this allows for more timely release of data and has the potential to be of higher quality. However, it also introduces uncertainty into the process as it is not always immediately obvious how EO data has been used. For example, there are many settings/variables involved in analysis EO data that can lead to different results. There needs to be a way of collating this information together and perhaps more importantly, a mechanism for reporting issues and suggesting improvements.	Across ONS several projects have been undertaken that have used varying amounts of EO data. Not all of these have been used to aid SDG reporting, but the methods used could very likely be used in a SDG context. For example, ONS' Data Science Campus have recently reported (https://datasciencecampus.ons.gov.uk/mapping-the-urban-forest-at-street-level/) on their use of Google Street View to calculate the density of trees and vegetation across the road network of all 112 major towns and cities in England and Wales. There is also a GitHub page (https://datasciencecampus.github.io/street-view-image-processing/) with further details of the image processing pipeline and associated code used. ONS' Data Science Campus are also currently working on methods using aerial photography to calculate how 'green' residential gardens are. This work is still in development, however, like the previously mentioned project, documentation will be publicly released when ready. Again, while this work is not being done specifically for the SDGs, the methods and best practice developed during this project could be adapted for different purposes. ONS would also be happy to share documentation following the research done on a global 9.1.1 indicator. That project highlighted a wider weakness in current EO data to address SDG indicators. Currently it could be argued EO data is part of a solution looking for a problem, when in fact the SDG agenda provides an excellent opportunity for EO data to address data gaps. For example, we would be happy to share our documentation where we suggest potentially applications for EO data to focus on. In the case of Indicator 9.1.1 this could mean using EO data to identify road material (i.e. tarmac,	We would like the EO4SDG or GEO to become a place to get authoritative answers to problems/issues regarding EO and the SDGs (both in technical setups and application of methods). For example, it would be really helpful to have case studies that explain how SDG indicators are calculated using EO data. These would need to explain how the process was completed (i.e. saying something was done on an ESRI platform or QGIS wouldn't be sufficient, it would need to be the exact settings or code used). It would also be great if the many resources out there for accessing EO data (all the hubs, portals, cubes etc.) were indexed in a central place (and examples of how particularly resources combined with a methodology can be used to generate particular SDG focused outcomes). Having such a resource would be especially beneficial in helping build capabilities and skills across those interested in producing SDG outputs. The UN Global Platform is available to all National Statistic Offices and their partners, so we would like to offer the opportunity to use the services and publish and SDG algorithms within the platform. Please note, the inputs provided in this survey are not an exhaustive list of contributions ONS could make to helping shape where EO4SDG and GEO should focus to support the use of EO for SDGs. Please feel free to contact us directly if you would like to discuss anything further. To summarise, these are the key points we have made across all questions in the survey and wish to reiterate: • ONS has thus far only used limited amounts of EO data for SDG analysis and reporting, however we have experience using EO data for non-SDG focused applications and are happy to share our experiences. • There is a desire to increase the amounts of EO data used by ONS to report on SDGs, but there are technological and methodological challenges that will need addressing before this can be done more frequently. • There are opportunities for EO data to focus on filling known data gaps in SDG reporting. However, while having access to these data are an important aspect of this, having detailed guidance on

		mud, gravel etc.). UN Global Platform publishes algorithms and methodologies within the Methods Service, https://methods.officialstatistics.org The UN Global Platform GWG has published the draft UN handbook on using satellite imagery for statistics, https://unstats.un.org/bigdata/taskteams/satellite/UNGWG_Satellite_Task_Team_Report_WhiteCover.pdf	how to handle and process the data (for different levels of geospatial expertise) also needs to be considered an essential part of the process. • The UK lacks a centralised authoritative resource for EO data (in terms of data availability, what research is/was being undertaken and methods/best practice). We highlighted this in our response to the UK's newly established Geospatial Commission's 'Call for Evidence' in November 2018 and would welcome any efforts made to provide such a function nationally (or internationally) by an authoritative body. • ONS is currently leading the development of United Nations Global Platform. https://unstats.un.org/bigdata/taskteams/globalplatform/ • There are various task teams developing algorithms, methodologies and training for using big data to create official statistics, including development of SDGs. • The Task Team on Satellite Imagery and Geo-Spatial Data aims to provide strategic vision, direction and development of a global work plan on utilising satellite imagery and geo-spatial data for official statistics and SDG indicators.. • The satellite task team has released a draft handbook on creating official statistics using satellite imagery, available here. https://unstats.un.org/bigdata/taskteams/satellite/UNGWG_Satellite_Task_Team_Report_WhiteCover.pdf • The UN Global Platform is currently in talks with Planet and AirBus to provide satellite imagery for the UN Global Platform until 2030 to support the SDGs • We have deployed an Earth Observation service within the UN Global Platform to support analysis of satellite imagery. Along with a location analytics service for analysing location based data, such as AIS, ADS-B and mobile phone data. • The UN Global Platform is available to all National Statistical Offices (NSOs) and their partners.

Organisation	Using EO data to compute specific national SDG indicators, working with National Statistics Office (NSO) and/or line ministry. (Please specify SDG indicator, EO data used, and how EO is being used.)	Planning or Considering Using EO data to compute specific national SDG indicators, working with National Statistics Office (NSO) and/or line ministry. (Please specify SDG indicator, EO data used, and how EO is being used.)	What are major challenges to your country in using EO data for SDG analysis and reporting (Others)	What type of satellite data is your organization using for SDG analysis and/or reporting? (Others)	What type of in-situ data is your organization using for SDG analysis and/or reporting? (Others)
CENTRE DE SUIVI ECOLOGIQUE (CSE DAKAR)	15.3.1, land cover, land degradation is assessed at various sites	15.3.1, Satellite land cover data, Planning to use satellite land cover data to monitor land cover change for land degradation analysis)			
Space Research Institute NAS Ukraine and SSA Ukraine	"Zero Hunger" (indicator 2.4.1) and "Life on land" (indicator 15.1.1 and 15.3.1) Sentinel-1, Sentinel-2, Landsat-8 data National and global land cover products	We developed informational technologies for monitoring indicators 2.4.1 (Proportion of agricultural area under productive and sustainable agriculture), 15.1.1 (Forest area as a proportion of total land area), 15.3.1 (Proportion of land that is degraded over total land area) For these indicators national landcover maps created with Sentinel-1/2 and Landsat-8 data with use of machine learning data are utilized.			In-situ data (collected over the territory of Ukraine) are used for land cover development. Statistical data of crop yield, sowing areas are used. Meteorological data are used for biophysical modelling
Harare Institute of Technology		GHG emissions - for MRV Land use/ land cover - for forests and sequestration purpose Hydrology system - determine the water availability to communities Wild life - heads count			
AGRHYMET REGIONAL CENTRE	Our mandate is to help ECOWAS countries to simplement all those initiatives particularly 15.3.1	15.3.1 to monitor land degradation analysis and estimate carbon sequestration in ECOWAS countries			Outputs from Seasonal forecasting models

UK Office for National Statistics	Indicator 11.6.2: Annual mean levels of fine particulate matter (PM2.5 and PM10) in towns and cities (population weighted) and Indicator 3.9.1: Mortality rate attributed to household and ambient air pollution. Both used modelled concentrations and are calculated on a 1km x 1km grid using a dispersion model using measurements taken from Defra's Automatic Urban and Rural network. Indicator 9.1.1: Proportion of the rural population who live within 2 kilometres of an all-season road. ONS undertook analysis looking at producing a global result for this indicator that could be broken down by initially by country and then any sub-region within a country. We used the GRIP (Global Roads Inventory Project) dataset for the roads which used satellite imagery to verify manual joins that had to be completed to connect roads crossing country borders. We also used the Global Human Settlement Layer (GHSL) for the population count and urban/rural split. The GHSL used a dasymetric approach to apportion demographic data to urban and rural areas with settlements as defined from satellite imagery. The UN Global Platform in development with ONS is supporting the analysis of satellite imagery and the development of algorithms and methodologies for SDGs. Including research into producing some of these automatically, using the Earth Observation, Methods Library and Machine Learning services within the Platform.	Unlike our current work on indicators such as 9.1.1, ONS are planning on using EO data directly (rather than relying on datasets that, in part, are derived from EO). We have a programme of work identifying any current data gaps or opportunities to disaggregate any of the current indicators to a smaller geographic data. EO data will have a role to play with this and we would be interested to know what other people are doing in this space. At present we have identified two indicators that can be calculated using EO data. Indicator 15.1.2: Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas; and 15.4.1: Coverage by protected areas of important sites for mountain biodiversity. For Indicator 15.1.2 we are planning on using satellite imagery (Sentinel and/or Landsat) to classify and compute forest area. The EO data source(s) have not been decided upon yet as we are still investigating the extent to which we want to incorporate a time series element into the reporting. For Indicator 15.4.1 we plan on using a Digital Elevation Model to map spatial extent spatial extent of mountain biodiversity. ONS has access to data through the Public Sector Mapping Agreement in England and Wales, part of this includes access to data provided by Aerial Photography for Great Britain (APGB). This includes a Digital Terrain Model at 5 metre resolution and a Digital Surface Model at 2 metre resolution. These data are derived from aerial photography taken of Great Britain. However, the agreement only covers Great Britain so we will need to use an alternative data source to calculate Northern Ireland. We are also exploring the use of spatial disaggregation techniques (like those used by the WorldPop project at the University of Southampton (http://www.worldpop.org.uk/)			

		to disaggregate data to smaller geographic levels. While we are still researching how best to adapt pre-existing methods, the concept of the work is to combine the application of established techniques with granular datasets available to ONS. This will require the use of EO data to create layers (such as night-time lights, terrain relief) to help allocate values. One of the goals of this work is to enable SDG indicators currently reported at a higher level of geography (such as Local Authority District, which, for a sense of scale, consisted of 391 areas across the UK) to be made available at much smaller geographic levels where appropriate. The UN Global Platform will make all SDG algorithms and methodologies available openly via the Methods Service. https://methods.officialstatistics.org			
ZAMG	SDG 2, 2.3.1: crop monitoring, land use, drought monitoring, soil moisture. SDG6, 6.3.2; SDG 11, e.g. 11.3.1, 11.3.2 urban planning etc; SDG13, 13.1.1; SDG15, 15.1.1 plus. Number of indicators based on https://sustainabledevelopment.un.org/content/documents/11803Official-List-of-Proposed-SDG-Indicators.pdf	SDG 2, 2.3.1: crop monitoring, land use, drought monitoring, soil moisture. SDG6, 6.3.2; SDG 11, e.g. 11.3.1, 11.3.2 urban planning etc; SDG13, 13.1.1; SDG15, 15.1.1 plus. Number of indicators based on https://sustainabledevelopment.un.org/content/documents/11803Official-List-of-Proposed-SDG-Indicators.pdf			
	1-October 18, 2013 Uruguay created the National Environmental Observatory (OAN). June 20, 2016 the National Secretariat of Environment, Water and Climate Change was created. July 7, 2017 the National Data Infrastructure for Environmental Management (INDAGeA) is created, with the objective of optimizing the collection, analysis and exchange of existing information from state institutions on issues related to the environment in order to prepare national indicators and indices: Exchange of spatial information on the territory, coverage and land uses., Exchange of information on continental bodies of water.,	National Active Geodetic Network of the Eastern Republic of Uruguay (REGNA-ROU) The Continuous Observation Reference Stations (CORS) are equipment that use the Global Navigation Satellite Systems (GNSS). Our country currently has 24 CORS, which make up the National Active Geodetic Network of the Eastern Republic of Uruguay (REGNA-ROU). The IGM operates one of the Official Data Processing Centers of the Geocentric Reference System for the Americas (SIRGAS), where observations are processed not only from the REGNA-ROU, but from other more than 100 GNSS stations belonging to to different active			

	Environmental information based on satellite images. 2- Geophysical Observatory of Uruguay (OGU). The OGU, was founded and is directed by Science Faculty and Engineering Faculty (National University) and by the Mining and Geology National Directorate. Since 2016, 14 Accelerometers have been acquired, and the OGU begins with the installation and monitoring of a network of seismological equipment. 3- The national observatory of the mean sea level is in its development phase. The Military Geographical Service and the Oceanographic, Hydrographic and Meteorological Service of the Navy are involved so far. It is foreseen the incorporation of the National Administration of Ports and the Faculty of Sciences of the National University. Its main objective is to observe with high precision the variability of the Mean Sea Level in the coast of our country. The determination of the magnitude of the change of the Mean Sea Level as a threat, and the determination of the corresponding vulnerabilities in the coastal strip of our country, will allow carrying out actions of prevention and mitigation of the risk.	networks of the continent (Argentina, Brazil,etc). The weekly solutions are made available to the Regional Combination Centers and the Analysis Center of the German Geodetic Research Institute (DGFI).			
Meteorological Service of Canada, Environment and Climate Change Canada	11.3.1.: “Ratio of land consumption rate to population growth rate”. Land cover data integrated with socio-economic data. 6.4.2 Level of Water Stress: Freshwater withdrawal as a proportion of available freshwater resources	For example, planning to use the Global Water data set (inter alia) to measure 6.6.1. “Changes in extent on water-related ecosystems over time”	It would be beneficial to define what is meant by “challenges”? Does it include research, statistical data acquisition, methodology development, publication pathway, etc, or data and processing		

			“problems” like inadequate funding, computing and staff resources? Using EO for SDGs requires a lot of work, and we are generally not funded to do this work. It may or may not match our current work flows and processes, so in that sense, it is a challenge.		
New Zealand Ministry for the Environment	15.1.1 Forest area, national land use and land cover mapping from Sentinel-2 data 15.4.2 Mountain green cover index, land cover mapping from Sentinel-2 data in conjunction with elevation data	Research into detecting changes in bare earth % in grazing context in optical satellite imagery will help with 15.3.1, land degradation. Also considering erosion scar detection from LiDAR.			
Mauritius Meteorological Services	(13.1.1-13.1.3) (Satellite and ground observation) (Analysis for weather forecast and issuance of Early Warnings)				
German Federal Agency for Cartography und Geodesy	Preliminary analyses of the use of EO data for calculating the following indicators are being conducted: 15.1.1: forest area and land area; Land cover/Land use data from the German Land cover model 15.4.2.: Mountain green cover index; data from the German Terrain model and the German Land model 11.7.1: built up area and open space; data from the German land cover model, imperviousness-HRL, and Sentinel-2	6.6.1: extent of water bodies from sentinel-1/-2/-3 14.1.1: Eutrophication; Sentinel-1/2 15.3.1: Degraded Land; Corine Land cover, Copernicus data Research regarding other possible indicators is being conducted			
Planning Authority, Malta		Use of Earth Observation through various spatial data sources including Copernicus Sentinel data, high resolution satellite data and UAV data. Such data will be used on a case-by-case basis as part of a national spatial data			

		strategy for applications such as land cover, coastal monitoring and/or urban monitoring.			
IGAC	Using Landsat, Sentinel and other optical and radar data to compute almost all national SDG indicators,	Planning to use satellite land cover data to monitor land cover change for land degradation analysis, deforestation, land administration, monitoring crops, prevention of disasters, toppgraphic, soils and cadastre map producion			
Eliot Christian	I am leading a world-wide initiative to establish a "Global-Scale Alert Hub for Official Emergency Alerts" (see http://alert-hub.org). In SDG# 11 and SDG# 13, this is especially relevant for Target 11.5 Reduce the Adverse Effects of Natural Disasters and for Target 13.3 Build Knowledge and Capacity to Meet Climate Change. In SDG# 3 and SDG# 4, this is relevant for Target 3D Improve Early Warning Systems for Global Health Risks and for Target 4.A Build and Upgrade Inclusive and Safe Schools	Especially with regard to SDG# 11, the Global-Scale Alert Hub for Official Emergency Alerts uses EO data in the context of Target 11.5 Reduce the Adverse Effects of Natural Disasters. Specifically, EO data is used for hazard threats such as: floods, typhoons, tsunami, earthquakes, landslides, and avalanches, among many others. We can also note that the dissemination of these emergency alerts leverages the satellite direct broadcast capability established through GEO.			
National Agency for Meteorology and Environmental Monitoring of Mongolia		Satellite land cover data, Planning to use satellite land cover data to monitor land cover change for land degradation analysis			
National Observatory of Athens, Greek GEO Office		Not yet mature at this level. There are first discussions between the NSO and the GEO Focal Point (Greek GEO Office) to establish a collaboration and start prioritizing needs on SDG reporting as well as developing the relevant workflows.	Note: the process is at an initial stage, so no further challenges have been yet identified to the ones selected.		
Tel Aviv Univeristy	soil spectral information from local national and global levels				
Statistics Netherlands		We are considering to do so, but still in the process of defining which indicators will be used in this process.			
Ministry of Environment,	For most indicators under SDGs 6, 7 9, 13,14,15	To improve the EO coverage currently being used for the ones currently being used for the indicators stated in the previous question			

Energy and Climate Change					
Statistics Sweden		Statistics Sweden is about to setup the national coordination for monitoring of global and national indicators, likely to find EO data useful for indicators monitoring the planet.			
Istituto Nazionale di Geofisica e Vulcanologia	Geophysical and Geochemical data for geo-hazard assessment, including seismic and volcanic hazard, tsunami hazard and anthropogenic hazard				
National Institute of Statistics, Ministry of Planning		The indicator relate to poverty, food security, disaster and climate change.		Received from other country that it has satellite.	
South African National Space Agency (SANSA)	11.3.1 Ratio of Land Consumption Rate to Population growth Rate, we used SPOT 5 and Landsat 5 to map and assess land consumption of selected big and small cities in South Africa.	11.2.1, satellite imagery and human settlement data, digital surface model, road network and statistical data to assess access to public transport 11.7.1, satellite imagery and products and non spatial data to map and assess access to public open space 11.1.1, satellite imagery, human settlement and statistical data to quantify people living in informal settlements 6.6.1, satellite imagery to map and assess extent of water bodies	Access to statistical data at the right scale		
Ministry of Environment, Ecology and Forest		15.3.1, We use Satellite land cover data to monitor land cover change for land degradation analysis We use satellite data to monitor the disaster (drought, flood, earthquake, cyclones), the level sea, the maritime piracy, the State of Environment, the bush of fire,			
INEGI		EO data are used for multiple purposes: basic geographic information (topographic, geo-statistical divisions, economic and population censuses, natural resources. Different types of data are used: high, medium and low spatial resolution. As well as different capture periods The way in which EO data is used depends on each stated objective.			
Ministry of Foreign Affairs of Brazil	EO data under use, but still in need of development, systematization and integration.	Same as previous answer			

Malaysian Meteorological Department	Earth observations data are use in: - forecasting weather, - monitoring and responding to natural disasters such as including fires, floods, earthquakes, and tsunamis, - predicting, adapting to and mitigating climate change.	- Meteorological Satellite data is use for weather monitoring inc of haze and hotspot monitoring - Seismometer, tide gauge and buoy use for earthquake and tsunami monitoring - ozone sonde data is use for measuring ozone concentration - radiosonde & pilot balloon is use for measuring atmospheric parameters which will be used in weather forecasting.	Financial constraint in set up and maintenance of the ground receiving station to place the instrument.		In-situ data of tide gauge and seismometer
Center for Ecological-Noosphere Studies NAS RA		• SDG target 6.6 By 2020 protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes: Indicator 6.6.1 Percentage of change in the extent of water-related ecosystem; • SDG target 15.3 By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world: Indicator 15.3.1 Proportion of land that is degraded over total land area) • SDG target 15.4 By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development Indicator 15.4.1 Coverage by protected areas of important sites for mountain biodiversity Indicator 15.4.2 Mountain Green Cover Index			
ONG Organisation pour l'Environnement et de la Développement Durable	NDVI, Indice de dégradation des terres, Indice de développement humain, Taux d'accroissement de la population, Nombre de ménages bénéficiaires des projets de restauration des terres, % des terres arides, % des terres cultivées, ...	Taux de progression des terres cultivées; taux de dégradation des terres, Taux de couverture de terres forestières,			

Survey Questions

Questionnaire: Uses of Earth Observation Data for SDG analysis and reporting by GEO Member Countries

Q1 Point of Contact information

- Name:
- Organization:
- Email address:

Q2. Is your country currently using EO data for SDG analysis and reporting?

☐ No, not using EO data. If so, please respond to Q3.

☐ Yes, currently using EO data for SDG analysis and reporting. If so, please respond to Q4

Q3. Is your country planning or considering to use EO data for future SDG analysis and reporting?

☐ Not planning or considering use of EO data for SDG analysis and reporting.

☐ Planning or considering to use EO data for SDG analysis and reporting. If so, please respond to Q5.

Q4. How is your country currently using EO data for SDG analysis and reporting?

☐ Using EO data in national progress report or its Voluntary National Report to UN High Level Political Forum (HLPF)

☐ Using EO data to compute specific national SDG indicators, working with National Statistics Office (NSO) and/or line minstry. (Please specify SDG indicator, EO data used, and how is EO data being used. For example, 14.3.1, pH data, Marine acidification is monitored at representative sampling stations)

Q5 How is your organization planning or considering using EO for future SDG analysis and/or reporting?

- ☐ Planning or considering to use EO for national reporting or Voluntary National Report to HLPF
- ☐ Planning or considering to use EO for computing SDG indicators, working with National Statistics Office and/or line ministry (Please specify SDG indicator, Type of EO data to be used, and How is EO data being planned or considered to be used. For example, 15.3.1, Satellite land cover data, Planning to use satellite land cover data to monitor land cover change for land degradation analysis)

Q6 What are major challenges to your country in using EO data for SDG analysis and reporting?
(Please select all that are appropriate)

- ☐ Finding relevant EO data
- ☐ Access to EO data
- ☐ Storage and processing of EO data
- ☐ EO data integration with statistical data
- ☐ Data quality assessment
- ☐ Data continuity or temporal coverage of data
- ☐ Data cost
- ☐ Lack of facility/human capacity to use EO data
- ☐ Compatibility with the current reporting method
- ☐ Reluctance to change current workflows and data flows
- ☐ Institutional coordination and bureaucracy
- ☐ Lack of understanding of values EO data provide
- ☐ Others

Q7 What types of EO data is your organization using for SDG analysis and/or reporting?
(Please select all that are appropriate)

- ☐ Satellite data. Please respond to Q8
- ☐ In situ data. Please respond to Q9
- ☐ Model output data (i.e., Earth System Models, Hydraulic models etc)

Q8 What type of satellite data is your organization using for SDG analysis and/or reporting?

- ☐ Raw data (i.e., sensor measurements as received from satellites)
- ☐ Processed Data (i.e., radiometrically and geometrically corrected data)
- ☐ Data products (i.e., processed data that describe real world variables such as chlorophyll-a concentration, rainfall rate, surface temperature, soil moisture or other essential variables)
- ☐ Information products (i.e., management relevant information for decision support, for example, eutrophication state of an open water body, flood risk for a river delta)
- ☐ Global datasets (i.e., land cover data, Digital Elevation Model, etc)
- ☐ Analysis Ready Data (i.e., data cubes and other data processed to a set of minimum requirements and organized into a form that allows immediate value-adding and analysis without additional user effort)
- ☐ Others

Q9 What type of in-situ data is your organization using for SDG analysis and/or reporting?

- ☐ National and/or Local in-situ data (i.e., rain gauge data, atmospheric data, etc)
- ☐ Global and/or regional in-situ data (i.e., global SST observed by voluntary ships, global CO2 measurements by voluntary aircrafts)
- ☐ Others

Q10 Do you have any other comments/lessons learned with regard to use of EO data for SDGs?

Q11 Do you have any good practice or project documentation that you are willing and able to share?

Q12 Please outline any specific support that you would like to receive from EO4SDG or GEO to support the integration of EO into your SDG processes.