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Assessing the maturity of EO activities at national level

Based on the GEO-CRADLE Maturity Indicators Methodology

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Abstract

Earth Observation (EO) is increasingly used across the globe in support of key societal challenges. To maximise its impact, decision makers and other actors along the value chain, require reliable data on the state and progress of different aspects of EO activities. In that context, we propose the use of "maturity indicators", as an independent, up-to-date and replicable methodology for the assessment and monitoring of EO maturity at national level. The aim of this approach, developed within the EU-funded H2020 GEO-CRADLE project, is to establish an analytical tool that allows the quantitative measurement of the current EO capabilities in a given country and their evolution over time. To that end, we have defined a set of indicators across three main fields: "Capacities", "Cooperation" and "National Uptake and Awareness". For each of the indicators, we developed a methodology to allow the assessment of its maturity level. In parallel, we established a standardized process for the collection and analysis of the necessary data. This entails primary research by organizations with deep involvement in national and international EO activities, enhancement through publicly accessible data sources and a cross-validation of findings by renowned national experts. This approach was tested over a period of 15 months, through the mobilisation of the GEO-CRADLE country partners, covering 11 countries from the Balkans, Middle East and North Africa. After analysing the collected data, we developed a standardised visualisation in the form of a "maturity card". The results of the implementation of the methodology are highly appreciated by the GEO Secretariat and the country representatives. The maturity cards have proven to be a powerful tool to highlight strengths and weaknesses, communicate on identified gaps, understand the level of uptake of key initiatives such as Copernicus and GEO, and guide future EO activities. Thus, the current results reflect the impact of long-term investment in EO activities, driven by the national strategy (e.g. Israel) or by European funds (e.g. Greece, Romania, Serbia). Moreover, gaps resulting from limited or discontinued involvement in international collaboration (e.g. Albania) are fully captured. In view of the lessons learned during the implementation of the methodology, we also highlight relevant limitations and present proposals for further improvement with regards to data collection and comparative analysis.

Keywords: GEO-CRADLE, GEO, Copernicus, maturity indicators, assessment, capacities, cooperation, uptake, awareness.

Nomenclature

GEO-CRADLE, maturity indicators

Acronyms/Abbreviations

European Association of Remote Sensing Companies (EARSC), Earth Observation (EO), Geo-information (GI), Group on Earth Observations (GEO), (Geoinformation / Geospatial) and Earth Observation ((G)EO), Global Earth Observation System of Systems (GEOSS), Region of Interest (RoI).

1. Introduction

Earth Observation data and services can support the informed implementation of numerous policies, help in addressing key societal challenges, and boost competitiveness and growth. The importance of sustained EO data and services has been underlined in several high-level fora and strategic communications. For instance, EO is seen as a key enabling technology for the achievement of the 2030 sustainable development goals agenda (Art. 76). Against this backdrop, and in view of the profound changes currently occurring in the EO sector, GEO and Copernicus envision a future where decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained EO.

In this context, the aspiration of GEO-CRADLE [1] (a project funded by the European Union under Horizon

2020 – GA Number 6901133) is to constitute the "cradle" of coordinated EO activities and capacities in North Africa, Middle East and the Balkans. This has been pursued over the past 3 years by fostering the creation of an integrated ecosystem of EO stakeholders, running pilot services in support of user needs and regional priorities and developing a series of tools that promote the implementation of GEOSS and Copernicus in the Region of Interest (RoI). In this effort, we have recognised that informing future actions and investments at national and programmatic level requires a thorough understanding of the current state-of-play of EO activities in the RoI.

Thus, we pioneered the development and implementation of the **EO Maturity Indicators** methodology [2] as an independent, reliable, robust and replicable way to assess the state and progress of different aspects of EO activities at national level.

2. Methodology

Our methodology is driven by the objective to

- Construct a thorough piture on the current state of play of EO activities in a given country
- Develop a robust way to collect and analyse the relevant data for each country
- Establish a common framework that allows the visualisation of the results of the assessment in an attractive and simple to understand and communicate manner.

In view of this, we quickly recognised that very little documentation exists on how to develop a maturity model that is theoretically robust, tested and widely accepted in the (G)EO domain. Thus, after consulting relevant approaches on benchmarking or comparative performance assessment methodologies implemented in other sectors [3,4,5,6], we adopted a three-step approach for the execution of the EO Maturity indicators methodology:

- During the **construction phase** we defined a set of indicators and reviewed existing approaches that could be utilised for the assessment of EO performance at country level against each of them.
- In the **deployment phase** we mobilised various resources for the collection, analysis and validation of the necessary data in each country. This was coupled with the definition of "ranges" for each indicator allowing us to quantify performances.
- In the **visualisation phase** we have developed maturity cards, a common framework allowing us to project the results of the deployment phase for each country.

2.1. Construction Phase

During this phase we have defined a set of maturity indicators against which the state and health of the Geoinformation and Earth Observation sector of the target country was to be measured and monitored in the GEO-CRADLE project. They were defined with the aim to help us construct an understanding of where the capabilities of a country are, and which way the country is going (projection and prospects). To support the definition of the indicators we also provided additional reasoning for the analysis we undertook. This provided assurance that the indicator was valid. We grouped the indicators under three main pillars**: Capacities, Cooperation, Uptake**. For each indicator we introduced an explanation of their parameters and an overview of their application boundaries, to subsequently guide the robust collection of data.

For some of them, the parameters and the relationship to the indicator was clear, while for others some explanation was needed to ensure a consistency of the analysis and successful compilation. The table below summarizes the major three pillars, Capacities, Co-operation and Uptake, and the corresponding indicators.

Table 1: Indicators by main pillar (capacities, collaboration, uptake)

Pillar	Group of Indicators	Indicators
Capacities	Infrastructure	-Space authority -Own space-borne -Access 3rd party mission -Ground-based facilities -In-situ monitoring networks -Modelling / computing facilities -(G)EO data exploitation platform
	Public (G) EO R&D	-# of public organizations -Employment public sector -Courses -Publications
	Industry base	-# of companies -Employment private sector -Resellers -Clusters

Cooperation	Collaboration GEO	-Participation in GEO Actions SDGs -GEO office -Data to GEOSS hub
	Impact Copernicus	-Actions on Copernicus / projects
	International Cooperation	-ESA -Participation Meteo agency -UN system -Infrastructure for Spatial -Standardization
	EU Funds	-R&D participation EU projects
Uptake	Networking	-Networking / events -Data portals
	Policy	-Policy -National budget investment
	Penetration	-Use -Capacity building

This set of indicators and the parameters defining each of them were validated by the country partners in the GEO-CRADLE consortium and by the GEO Secretariat.

Equipped with a commonly agreed grid of indicators we then set off to design a robust assessment method of the EO maturity of each of the countries in the RoI. To that end, we took into account relevant concepts such as the one discussed by Geospatial media [7] in 2017 and other initiatives from UNGGIM [8]. Based on the data gathered by the GEO-CRADLE project at country level during an extensive gap analysis, we proposed five practises to set the ground for the investigation of country maturity. Some of these approaches were rejected, and others kept, as discussed below.

Practises included:

- **Integration of information** from other project tasks contributing to the evaluation of country capacities. This includes the extensive inventory [9] built by GEO-CRADLE, the user requirements analysis and the dedicated gap analysis [10].
- **Desk research** by country partners based on available literature, publications. Contribution with their insights and expertise into the topics covered by the maturity indicators.
- **Semi-structured interviews** with country partners and validation of findings by external, independent experts.
- **Follow-up analysis** required concerning incomplete data or N/A.
- **Comparative assessment** of the results based on previous approaches and visualisation formats. This led to an interpretation of the findings (country level analysis) represented in the form of maturity cards.

Approaches declined:

- **Normalisation**: Each country performs differently in various aspects and this could distort country level comparisons; this includes parameters such as economic performance, population, investment, competition, just to name a few. Furthermore, countries are in different stages of development which may affect the metrics used to evaluate the EO sector performance.
- We reviewed **benchmarking** approaches [4, 5, 6, 11] that would allow us to establish reference points for each indicator. However, the implementation of a full benchmarking approach would exceed the scope and available resources within the GEO-CRADLE project (given the complexity of establishing benchmarks that are applicable across countries with different GDPs, income levels, different population and, of course, different EO needs). Therefore, whilst we recognise that future studies into the applicability of benchmarking could strengthen the overall EO Maturity indicators methodology, we have not set out to establish "global" benchmarks, whereby we would assign values to the maturity indicators based on the identification of the best performing country in each.

2.2. Deployment phase

2.2.1. Collection of data

The necessary, up-to-date information to substantiate the performance of each country in the RoI against each indicator was collected by the country partners in the GEO-CRADLE consortium. These are entities with a prominent role in national and international EO activities, as leading research or industrial organisations (see full list in Appendix A). The country partners adopted a variety of strategies to deliver results such as relying on existing networks, asking for referrals to other EO actors, consulting the results of other projects or organizing workshops with key EO actors. Any lack of information was addressed by extensive desk research and by consulting the extensive gap analysis carried out by the project.

2.2.2. Assignation of maturity levels

Once the country partners submitted the necessary information for each maturity indicator, we set out to define meaningful boundaries that would allow us to assign performance scores. The grouping levels were adapted from the capability maturity models in [12,13].

- L0 – Initial: This value indicates very weak performance and as such helps to raise awareness to the fact that the given country requires significant guidance and/or support to boost its performance
- L1 - Basic: The value describes country practices that are in early pilot use and are demonstrating some successful results
- L2 - Intermediate: The value defines country practices that are in limited use in industry or government organizations for the (G)EO sector
- L3 - Advanced: The value explains country practices that have been successfully deployed. Case studies are typically available to evaluate this level
- L4 - Optimized: The value designates practices that have been fully integrated and optimized by the country

Appendix C presents a more detailed table with the exact meaning of values 0-4 for each individual indicator.

This approach as well as the detailed ranges for each indicator were consolidated following extensive exchanges with several stakeholders in the GEO community the country partners and independent experts. With this consolidated picture of maturity levels in hand, we were then able to produce a preliminary visualisation of the results for each country in the form of maturity cards (more information on the visualisation follows).

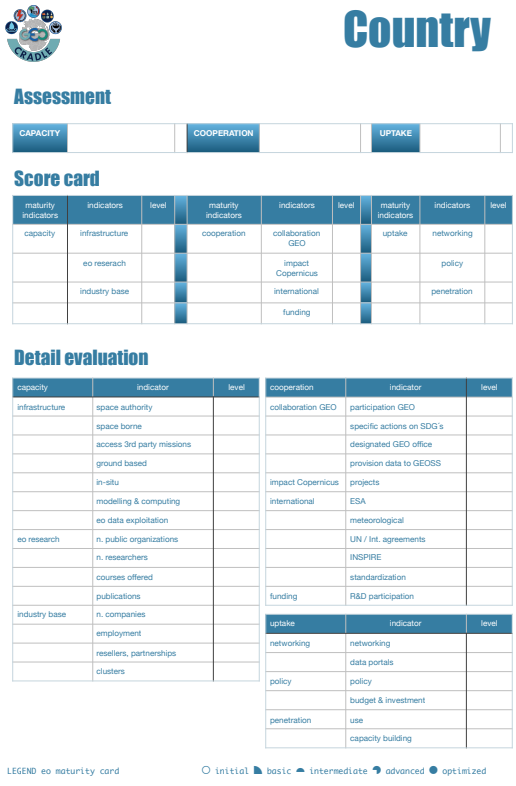
2.2.3. Validation

The preliminary results where then presented and validated by a number of independent EO experts for each country. These external experts (between 2 to 5 individuals per country) were fully briefed on the overall maturity indicators approach as the proposed methodology for the assessment and monitoring of EO maturity at national level. We explained the approach to establish an analytical tool that allowed quantitative measurement of the current EO capabilities of the country and their evolution over time. The experts appreciated the introduction and clarifications on the validation process which helped them to better produce their complementary assessment. The current EO/GI expertise from experts was sufficient to provide the required feedback on the discussion about the different maturity levels (L0 to L4) for indicators & sub-indicators corresponding to major pillars of the EO activities in their countries. The contribution of the different experts was very important to help ensure that maturity indicators for the Countries in the Region of Interest were validated and met the objective to construct a comprehensive and accurate (G)EO picture in the Region.

2.2.4. Visualisation in Maturity cards

We have designed maturity cards as our standardised "canvas" for the visualisation of EO Maturity per country. In this regard, the maturity cards present a quasi-quantitative snapshot of the Earth Observation capacities in the countries within the GEO-CRADLE area and constitute an easy-to-communicate framework for the projection of EO performance (both across countries and over time).

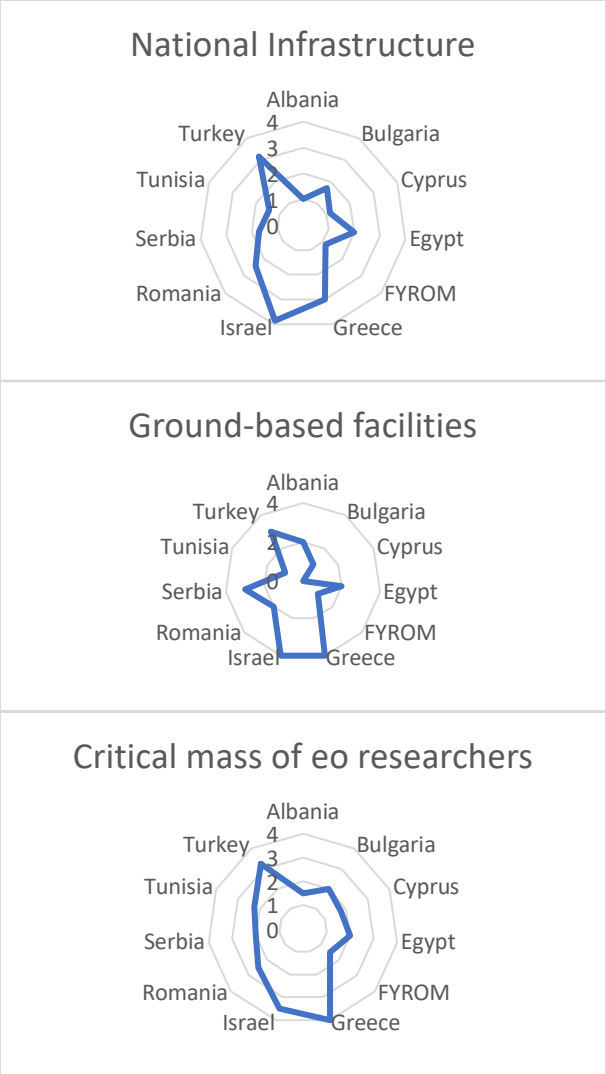
Figure 1: Maturity card model

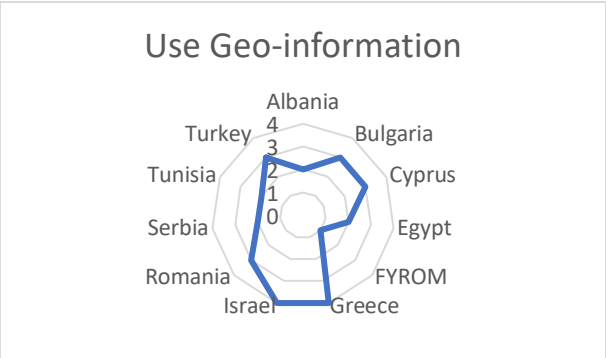


3. Results

Looking at an aggregate of all 32 indicators of the data collected but also at the comparison of individual indicators across countries we observe large discrepancies in the resulting maturity levels. Thus, the maturity cards show high level of maturity in Greece and Israel and the lowest level in Albania and FYROM. This is also reflected on the spider diagrams presented below.

Figures 2-9: Examples - Grouping the Countries/ Indicators





Figures 10-12: Examples - Country maturity / global indicators

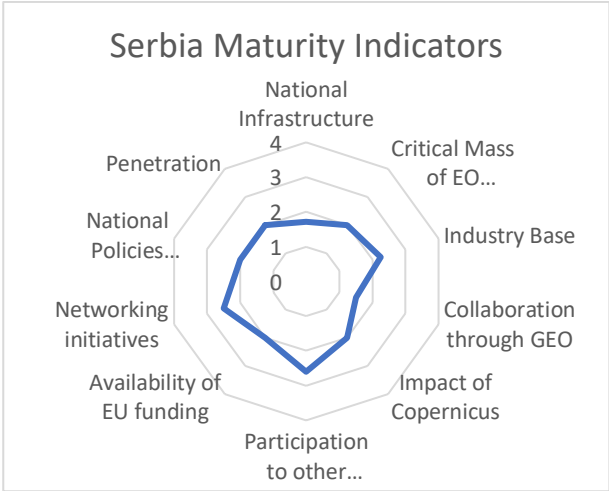
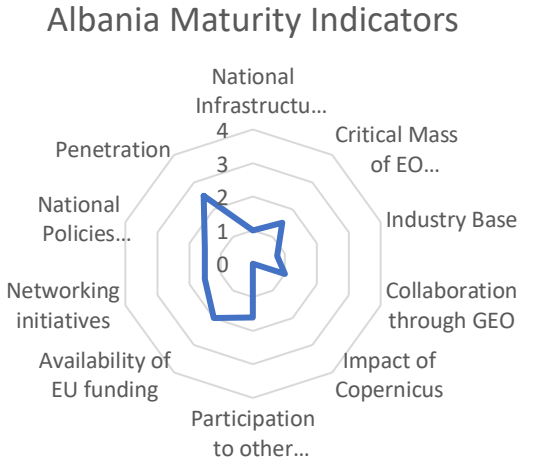
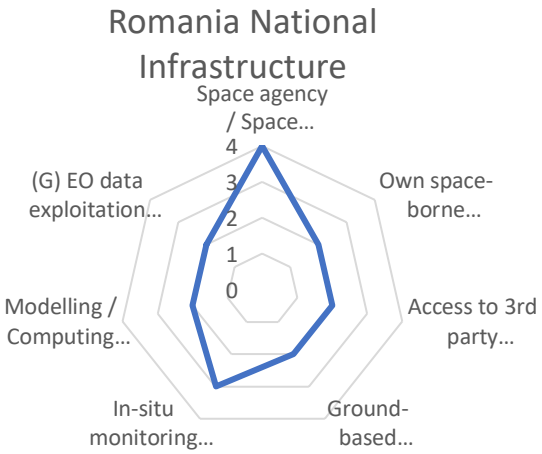


Figure 13: Example Country maturity / indicator pillar





Figures 14-15: Examples Maturity cards from Greece and FYROM

A more detailed evaluation follows:

Greece shows the highest level of maturity in the GEO-CRADLE region. The lowest indicators are found in the capacities pillar in relation to the relative lack of own space-borne capacities (under national infrastructure) and limited existence of clusters; these are thus areas that could be improved. Under collaboration, the indicator reflecting standardization could also be improved. In terms of uptake, Greece has been performing very well, possibly owing to its long-term involvement in Copernicus and ESA programmes.

Israel displays an excellent maturity in terms of capacities. Whilst collaboration activities are wide spread there seems to be still some way to go. The lowest indicator is related to the impact of Copernicus and to the establishment of infrastructure for spatial information. Referring to the uptake, perhaps more networking and awareness events will help; similarly, more could be done for increased use of EO in support of policy priorities.

Turkey presents quite mature and consistent performance across the three main pillars (capacities, collaboration and uptake); in the case of the latter, the country performs with increasing success and has been achieving continuous improvement. The collaboration with GEO is recommended to be improved, even if it is already playing a significant role. Issues with harmonization and standardization might also deserve more attention. Moving to the industry component, and recognising that it has been improving, we note that more can be done perhaps through cluster-driven collaborations.

Romania shows an advanced maturity in the region. Collaboration is strong in all components, but the impact of Copernicus deserves more attention. The country has good prospects for improvement in the area of exploitation of EO services. The lowest performing set of indicators for Romania falls into the capacities pillar, though at an intermediate level. National infrastructure will merit more responsiveness from the government and ROSA might help to mobilize resources in that direction, in addition to the industry indicators.

Serbia performs at an intermediate level. It has some very strong indicators, but others are still at the initial phase. One possible red flag corresponds to the low performance in terms of national infrastructure (space authority, own-space borne and access to 3rd party missions) under capacities while the rest of indicators in this pillar are at basic/intermediate level. Serbia should improve through engagement with GEO or ESA and the recently formulated cooperation with EC under the Copernicus programme.

Tunisia is in a similar mid-level position. Probably the stronger indicators are the ones referring to the engagement with the meteorology sector but also with the UN system, as well as capacity building or the EO activities in research institutions. Low values are concentrated in the Capacities pillar, specifically under the national infrastructure: ground-based facilities, in-situ monitoring networks or modelling and computing capacities. Likewise, Tunisia shall mobilise resources for the development of the industry sector in the country.

Bulgaria has a basic maturity, nevertheless, it is intensely improving in the recent months through various actions motivated by the EU presidency but also thanks to increased engagement with PECS under ESA cooperation. The policy engagement seems quite strong and suggested at least to keep that level in the future and to mobilize resources in weak directions such as the area on collaboration (especially with GEO), which justifies more attention as the indicators feeding that group are rated quite low. The stronger position falls into the capacities pillar, probably through the past experience in the space sector.

Cyprus merits attention in the capacities pillar where an important group of indicators is labelled as initial stage, including on the national infrastructure (own space-borne, access to 3rd party missions, in-situ monitoring networks) and the industrial component. The strongest values are for the collaboration, especially on the meteorology sector but also in relation to establishing the infrastructure for spatial information. Good performance is also noted in connection to the engagement with the monitoring and reporting of some SDGs.

Egypt deserves attention in the collaboration pillar, where it has reached an intermediate level. This is thanks to running an independent space programme; in contrast, the lowest value falls into collaboration with GEO, Copernicus, UN while the cooperation with meteorological organizations is stronger. The strengthening of the private sector also deserves support. The uptake pillar falls into the basic level with particular attention required for data sharing and the national policies implementation.

Albania is at the basic level. Comparing the three main pillars, Albania scores relatively high in the uptake where penetration (capacity building) has a high rate when it is plotted against the rest of indicators; contrary to that, the country is quite weak on capacities where national infrastructure (specially on space-borne and third-party missions), research (publications indicator) and industry base are initial or basic. In collaboration, the impact of Copernicus should be significantly improved, as well as the cooperation with GEO or the UN system.

FYROM is placed as the lowest maturity level in the region. Most of the indicators highlight the need of resources to help the country move from initial to basic. The best pillar is the uptake but some individual indicators in collaboration are standing out: cooperation with meteorological organisations, participation with UN system entities or establishing the infrastructure for spatial information. Some small mobilisation of resources will bring important impact on the evolution of its maturity.

4. Discussion

The implementation of the maturity indicators methodology allows a country to gain insight into the current situation of EO-related activities and capacities and how it should pursue the desirable situation (i.e. a higher maturity level). The proposed methodology is a tool to highlight the critical factors to lead to successful (G)EO strategy implementation. The maturity indicators are meant to inform countries on the need to mobilize appropriate resources; their position on the card combined with the knowledge of best practices in better-performing countries is thus pointing towards the sort of measures which could be taken.

The application of the methodology gave rise to significant benefits. In summary, it:

- Established a relatively simple to understand and replicate approach, whereby the indicators offered a useful ‘initial step’ and provided a common language of communication which helped to understand performance.
- Provided the countries with a collection of quantitative data to back up the understanding of the sector and its maturity.
- Delivered quality feedback to drive direction of involvement in the EO sector and postulated a way to see if the investment in the (G)EO sector was working.
- Presented evidence to support decision-making in future actions and focus attention on what matters most, offering risk triggers and early warning signs.
- It was appreciated by partners and experts, thanks to its simplicity and the straightforward (yet challenging!) way to gather, analyse and visualise data. Improvements in the construction of the final maturity cards were

achieved following direct exchanges with independent experts.

The implementation of the methodology also confirmed that the comparison of country performance is a complex process; a single set of indicators cannot be used to uniquely decide the maturity of a country. Rather, the assessment we have performed can provide the basis to substantiate a first-order "defensible" level of maturity, by supplying a chain of semi-quantitative evidence that can be used to support the assignment of given “scores” against the different indicators.

Some limitations were presented:

- In many respects, the final outcome is sensitive to the quality and completeness of the collected information. The overall success of the methodology is thus dependent upon robust data collecting mechanisms. In that regard, the setting of GEO-CRADLE allowed us to mobilise prominent EO organisations in the respective countries through networking events and direct contacts, as well as to consult external experts for data validation.
- In the same vein, the availability of data, and the capacity to process it was a barrier for the deployment of complex indicators. Country partners noted that significant resources were required to collect data and regularly update it; therefore the volume of data collected was an issue in some of the countries and contributed to the “bias” of some of the indicators.
- Some subjective elements and room for interpretation was presented at the definition level, therefore the criteria for indicators ought to be further reviewed in future projects. The additional insight offered by more complex indicators will need to be considered in conjunction with a country’s institutional capacity and data availability.

5. Conclusions

The vision of GEO-CRADLE is to pave the way for the sustainable and continuous uptake and exploitation of Earth Observation services in North Africa, Middle East and the Balkans. Through the elaboration of the novel maturity indicators methodology, the project aspires to build adequate knowledge of the level and progress of GEO and Copernicus involvement in each country. Applying this methodology, we were able to highlight the critical indicators for each country and provide meaningful insights towards the successful (G)EO strategy implementation. In that regard, the maturity indicators feed the GEO-CRADLE ecosystem of EO actors with valid and instrumental information for the development and implementation of a long-term roadmap that considers an accurate picture of EO maturity in the region.

While some weaknesses and limitations remain, the methodology has made considerable progress in developing a robust approach for which there was little existing prior information. Thus, we look forward to working together with other stakeholders to further develop and strengthen the methodology.

Acknowledgements

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Appendix A (GEO-CRADLE partners contributing to data collection and analysis)

- National Observatory of Athens (NOA) - Coordinator (Greece)
- Interbalkan Environment Center (IBEC) (Greece)
- Center for Environment and development for the Arab Region and Europe (CEDARE) (Egypt)
- Research and Studies Telecommunications Centre (CERT) (Tunisia)
- Tel Aviv University (TAU) (Israel)
- Cyprus University of Technology (CUT) (Cyprus)
- TUBITAK UZAY Space Technologies Research Institute (UZAY) (Turkey)
- Space research and technology institute (SRTI) (Bulgaria)
- National Institute of R&D for Optoelectronics (INOE) (Romania)
- University of Ss Cyril and Methodius (USCM) (FYROM)
- Institute for Nature Conservation in Albania (INCA) (Albania)
- Institute of Physics Belgrade (IPB) (Serbia)
- Academy of Athens (AOA) (Greece)
- INOSENS (INS) (Serbia)
- European Association of Remote Sensing Companies (EARSC) (EU)

Appendix B (Maturity levels – short version)

CAPACITIES	level 0	level 1	level 2	level 3	level 4
National Infrastructure: It will understand the Earth Observation Strategy by country.					
Space agency or designated Space Authority	[no authority]	[1 ministry]	[1-various ministries]	[1 authority]	[1 operational authority/agency]
Own space-borne capacity	[no missions]	[generic space-borne interest]	[1 EO mission]	[2-5 missions]	[> 5 missions]
Access to 3rd party missions (with own ground stations)	[no access missions]	[access 1one 3rd party mission]	[access 2 to 5 3rd party missions]	[access between 5-10 3rd party missions]	[access > 10, 3rd party missions]
Ground-based facilities	[no ground-based capacity]	[1 station]	[2 to 5 ground stations]	[6-10 stations]	[> 11 ground stations]
In-situ monitoring networks	[no in-situ capacity]	[at least one in-situ network]	[between 5 to 10 in-situ networks]	[between 10-20 in-situ networks]	[more than 20 networks]
Modelling and computing capacities	[no modelling capacities]	[one HPC]	[between 2 to 10 modelling capacities]	[between 10-20 modelling capacities]	[more than 20 modelling capacities]
(G) EO data exploitation platforms (provision of VA services and products)	[no exploitation platforms]	[one exploitation platform]	[2-5 exploitation platforms]	[5-10 exploitation platforms]	[> 10 exploitation platforms]
Critical Mass of EO researchers: Identification of the different groups of researchers both in research institutions & universities/academia and how big these groups are.					
Number of public organizations	[no (G) EO research/Univ. departments	[one (G)EO organization]	[between 2-10 (G)EO organizations]	[between 11-25 (G)EO organizations]	[more than 25 (G)EO organizations]

	centers]				
Number of researchers (in Univ. & R&D labs)	[no significant (G)EO staff]	[less than 50 (G)EO employees]	[between 50-250 (G)EO employees]	[between 250-500 (G)EO employees]	[> than 500 (G)EO employees]
Courses being offered in universities, its diversity and maturity offered	[no (G)EO courses]	[between 1-10 (G)EO courses offered]	[between 10-50 (G)EO courses]	[between 50-100 specialized (G)EO courses]	[> 100 specialized (G)EO courses]
Relevant Publications	[no (G)EO publications]	[1-25 papers]	[25-100 papers]	[100-500 papers]	[> 500 papers]
Industry Base: The goal here is to get a wide picture of the number and geographical distribution of EO companies per country.					
Number of companies	[no companies on (G)EO]	[between 1-5 companies]	[between 6-25 companies]	[between 26-50 companies]	[> 51 companies]
Scale of companies (large/medium/small/ micro)	[no comparable]	[micro]	[small]	[SMEs]	[all types industry]
Employment numbers, levels and changes	[up to 10 employees]	[10-50 employees]	[51-150 employees]	[151-300 employees]	[> 300 employees]
Resellers or local representatives of European companies	[no resellers]	[1 reseller]	[2-5 resellers]	[6-10 resellers]	[> 10 resellers]
Existence of Clusters	[no clusters]	[1 cluster]	[2-5 clusters]	[6-10 clusters]	[>10 clusters]
COLLABORATION	**level 0**	**level 1**	**level 2**	**level 3**	**level 4**
Collaboration through GEO: Information on the country relations with international GEO Secretariat Geneva, GEO Plenary Meetings & Ministerial Summits.					
Participation in GEO or to projects/initiatives which are linked to GEOSS	[no participation GEO]	[participation 1 project]	[participation >2 project initiatives]	[designated representative active in GEO plenaries]	[designated representative active in GEO plenaries & contributing to budget lines]
Specific actions on Sustainable Development Goals (SDG´s)	[no SDGs actions]	[1 SDGs action]	[2-5 SDGs actions]	[5-10 SDGs actions]	[5-10 SDGs actions last 3 years]
Designated GEO office	[no office]	[plans for office 1 staff coordinating GEO act.]	[1 organization supervising GEO activities]	[Truly dedicated office no staff]	[Truly dedicated office with own staff/5 years]
Provision of data to GEOSS	[no data to GEOSS]	[plans for data to GEOSS]	[1-5 datasets to GEOSS]	[6-15 datasets to GEOSS]	[provision >15 datasets to GEOSS]
Impact of Copernicus: This section will evaluate the type of engagement with Copernicus projects and actions (projects involvement) with Entrusted Entities.					
Organisations involved in projects	[no projects using	[1-5 projects using	[6-25 projects using	[25-50 projects using	[< 50 projects using Copernicus

linked to Copernicus	Copernicus services]	Copernicus services]	Copernicus services]	Copernicus services]	services]
Participation to other international efforts: Level of international collaboration to ensure country access to essential global EO information.					
ESA	[no cooperation agreements with ESA]	[plans cooperation agreements with ESA]	[participation under some ESA activities]	[ESA European Cooperating State Agreement]	[ESA full member]
Meteorological: WMO, EUMETSAT, ...	[no cooperation meteo]	[participation national Meteo]	[participation National Meteo & sporadic Int. cooperation]	[participation National Meteo & Int. Cooperation & one international membership: i.e: EUMETSAT, or WMO, etc]	[participation National Meteo & Int. Cooperation & more than one membership, i.e EUMETSAT & WMO]
UN system as UN-GGIM, ...	[no participation UN bodies]	[at least 1 active participation in UN agency/organzation]	[participation in 2-5 UN agencies/organzations]	[participation in >6 UN agencies/organzations]	[participation >6 UN agencies/organzations/10 years]
Establishing an Infrastructure for Spatial Information [ie. European Community (INSPIRE)]	[no directive for Spatial Information]	[plans to establish a directive for Spatial Information]	[one requirement for a directive for Spatial Information]	[2-3 requirements for a directive for Spatial Information]	[full implementation for a directive for Spatial Information]
Participation in Standardization organizations i.e. as OGC...	[no engagement with Standardization discussions]	[one organization engage with Standardization discussions]	[2-5 organizations engage with Standardization discussions]	[6-10 organizations engage with Standardization discussions]	[> 10 organizations engage with Standardization discussions]
Availability of EU funding.					
R&D participation or other EU programmes	[no EU R&D participation]	[one EU R&D participation]	[2-10 EU R&D participation]	[11-20 EU R&D participation/sustained 5 years]	[11-20 EU R&D participation/sustained 10 years]
UPTAKE & AWARENESS	**level 0**	**level 1**	**level 2**	**level 3**	**level 4**
Networking initiatives: Events which examine and discuss the many different aspects and applications of the Earth Observation and geo-information field from the thematic or market point of view					
Networking initiatives (events and thematic workshops)	[no networking]	[1-5 networking activities/year]	[6-15 networking activities/year]	[> 25 sustained networking activities/year]	[sustained 16-25 networking activities/year]
Data Portals	[no data portals]	[plans data portals]	[one data portal]	[> one data portals in various thematics]	[> one data portals in various thematics and fully integrated]
National Policies Implementation.					

Policy	[no national policy on (G)EO aspects]	[one national authority/minister engage with on (G)EO aspects]	[2-5 national authorities/ministers engage with on (G)EO aspects & collaboration at international level]	[>5 national authorities/ministers engage with on (G)EO aspects & collaboration at international level]	[dedicated national institution engage with on (G)EO aspects & collaboration at international level]
Budget & investment (internal to the country)	[no budget line designated to (G)EO activities]	[one budget line designated in other dominas where (G) EO is used]	[one dedicated budget line designated to (G)EO activities]	[2-5 budget lines designated to (G)EO activities]	[2-5 budget lines designated to (G)EO activities 7 last 10 years]
Penetration.					
Use of Geo-information	[no use (G)EO /penetration]	[sporadic activities in (G)EO / low penetration]	[one dedicated activity in (G)EO / medium penetration]	[2-5 dedicated activities in (G)EO / advance penetration]	[> 5 dedicated activities in (G)EO / fully optimized penetration]
Capacity building EO focused actions	[no capacity building actions]	[one capacity building action]	[2-5 capacity building actions]	[6-10 capacity building actions]	[>10 capacity building actions / 10 years]

Appendix C (Country indicators summary table)

	Albania	Bulgaria	Cyprus	Egypt	FYROM	Greece	Israel	Romania	Serbia	Tunisia	Turkey
CAPACITIES											
National Infrastructure	1,00	1,71	1,14	2,00	0,86	3,00	3,86	2,43	1,71	1,43	3,14
Space agency or designated Space Authority	2	2	1	2	0	3	4	4	0	2	2
Own space-borne capacity	0	1	0	3	0	1	4	2	0	1	3
Access to 3rd party missions (own ground stations)	0	2	0	1	1	3	4	2	0	2	3
Ground-based facilities	2	1	0	2	0	4	4	2	3	1	3
In-situ monitoring networks	1	2	3	2	2	3	3	3	2	1	4
Modelling and computing capacities	1	2	2	2	1	3	4	2	3	1	3
(G) EO data exploitation platforms (provision of VA services and products)	1	2	2	2	2	4	4	2	4	2	4
Critical Mass of EO researchers	1,5	2	1,75	2	1,5	4	3,5	2,5	2	2,25	3,25
Number of public organizations	3	2	2	2	2	4	3	3	2	3	3
Number of researchers (in Univ. & R&D labs)	2	2	2	2	1	4	4	3	2	2	3
Courses being offered in universities, its diversity and maturity offered	1	2	2	2	2	4	4	2	2	2	4
Relevant Publications	0	2	1	2	1	4	3	2	2	2	3
Industry Base	0,75	1,75	0,5	1,25	0,25	2,75	3,25	2,25	2,25	1,5	2,5
Number of companies	1	2	1	1	1	4	3	2	2	2	3
Employment numbers, levels and changes	1	2	1	1	0	4	4	3	2	1	3
Resellers or local representatives of European companies	1	2	0	2	0	2	3	2	3	2	2
Existence of Clusters	0	1	0	1	0	1	3	2	2	1	2

COLLABORATION	Albania	Bulgaria	Cyprus	Egypt	FYROM	Greece	Israel	Romania	Serbia	Tunisia	Turkey
Collaboration through GEO	1	0,75	1,5	0,5	0,5	4	2	3,5	1,5	1,5	2
Participation in GEO or to projects/initiatives which are linked to GEOSS	1	1	1	1	0	4	3	4	0	2	3
Specific actions on Sustainable Development Goals (SDG´s)	1	0	3	0	2	4	3	4	0	2	2
Designated GEO office	0	1	2	1	0	4	2	3	2	1	2
Provision of data to GEOSS	2	1	0	0	0	4	0	3	4	1	1
Impact of Copernicus	0	2	1	1	0	4	1	2	2	2	3
Organisations involved in projects linked to Copernicus	0	2	1	1	0	4	1	2	2	2	3
Participation to other international efforts	1,6	2,8	2,2	1	1,2	3,6	2,4	3,6	2,6	2	3
ESA	0	3	3	1	0	4	2	4	0	1	3
Meteorological: WMO, EUMETSAT, …	4	4	4	3	2	4	4	4	4	4	4
UN system as UN-GGIM, …	0	1	0	1	2	4	2	4	3	3	3
Establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)	2	4	4	0	2	4	1	4	4	0	3
Participation in Standardization organizations i.e. as OGC…	2	2	0	0	0	2	3	2	2	2	2
Availability of EU funding	2	2	3	2	2	3	4	4	2	2	3
R&D participation or other EU programmes	2	2	3	2	2	3	4	4	2	2	3
UPTAKE	**Albania**	**Bulgaria**	**Cyprus**	**Egypt**	**FYROM**	**Greece**	**Israel**	**Romania**	**Serbia**	**Tunisia**	**Turkey**
Networking initiatives	1,5	1,5	1,5	1,5	1,5	4	2,5	2,5	2,5	1,5	3
Networking initiatives (events and thematic workshops)	1	2	1	2	1	4	2	3	2	2	3
Data Portals	2	1	2	1	2	4	3	2	3	1	3
National Policies Implementation	1,5	2	0,5	1	0,5	3,5	2,5	3,5	2	2	3
Policy	2	3	1	1	1	4	2	4	3	2	3
Budget & investment (internal to the country)	1	1	0	1	0	3	3	3	1	2	3
Penetration	2,5	2	2,5	2	1	4	4	2,5	2	2,5	3
Use of Geo-information	2	3	3	2	1	4	4	3	2	2	3
Capacity building EO focused actions	3	1	2	2	1	4	4	2	2	3	3
MATURITY INDICATORS	1,29	1,85	1,49	1,43	0,91	3,52	3,00	2,85	2,04	1,80	2,88