GEO-CRADLE

Roadmap for the future implementation of GEOSS and Copernicus

in the Balkans, Middle East and North Africa regions

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Coordinating and integrating state-of-the-art Earth Observation Activities in the regions of North Africa, Middle East, and Balkans and Developing Links with GEO related initiatives towards GEOSS

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1 Executive Summary

In the past 3 years, GEO-CRADLE has been coordinating a multitude of different EO-related activities across the North Africa, Middle East and Balkans regions (NAMEBA). This included multiple regional workshops, several analytical studies (e.g. gap analysis, maturity indicators, priorities against regional challenges, etc.) and a set of well-targeted efforts to address specific issues in the region (establishment of Regional Data Hub and networking platform, execution of feasibility studies). Thanks to all these activities, the partners of GEO-CRADLE had the unique opportunity to interact with many EO actors across the whole value chain and over the entire region. The wealth of information collected in this process, brings us today to a position in which we can more securely attempt to answer some key questions:

- **Where are we now?** What is the current state-of-play with regards to EO activities in the NAMEBA region? What challenges is the region still facing? What is the footprint of GEO, GEOSS, Copernicus and other international activities?
- **Where do we want to be?** What is the future we are trying to shape and what is the role of EO in it? Where do we want to direct investment to?
- **How can we get there?** Which actions shall we undertake as an EO community to support informed decision making in this region? Which collaborative activities shall we carry out to achieve the desired future we envisage?

Providing well-justified answers to these questions is the purpose of this roadmap. In that regard, we are attempting to envisage a future for EO activities in the NAMEBA region that whilst being ambitious is also realistic. Its primary focus is on the future implementation/uptake of GEO/GEOSS and Copernicus in the NAMEBA region. In that context, our aim and hope is that the final output of this effort will be truly actionable, i.e. enabling the involved actors to take meaningful action towards maximising the benefits of EO in the region.

In practice, we hope that policy makers (both at EU and national level) will be better informed when drafting future work programmes; multipliers (e.g. associations and networks) will be better equipped to guide their members with regards to EO activities in NAMEBA; researchers and companies will be more aware of collaboration or market opportunities. To that end, we have adopted a rather direct approach defining in very clear terms **who should be involved**, **what should they focus on, how shall they go about implementing these actions and in which timeframes (when).** These elements are combined in the form of an action plan that should be considered a "living" document. It is structured so that the different actions fall under five main categories: (i) Infrastructure and data exploitation, (ii) EO in support to policy implementation and decision-making, (iii) Ecosystem Capacity Building, (iv) EO Services Sustainability and (v) Uptake. For each of these categories we have taken into account potential "low-hanging fruit" or "quick wins" vs. longer-term perspectives.

All in all, we hope that this roadmap will pave the way for informed follow-up activities which will further promote multi-actor, cross-border and interdisciplinary collaboration among EO stakeholders in the NAMEBA region, and help deliver EO-based benefits to society and economy.

This Copernicus Sentinel-2A image features Aswan and surrounding area, in South Egypt. Released 10/07/2017

2 Why do we need a roadmap?

2.1 NAMEBA: a diverse region of key strategic importance in the neighbourhood of Europe

The strategic importance of the Balkan, Middle East and North Africa regions for Europe is not rooted merely on their geographic location in its immediate neighbourhood. Thus, whilst these regions are characterised by high intra and cross-regional diversity in terms of languages spoken, cultures, socio-political and religious systems, etc. they are tightly connected to Europe not only by land or sea but also by a wide spectrum of commonly faced challenges and by a vision to carve a brighter future for all citizens, together.

In this regard, climate change, population growth and its impact on food security, overexploitation of natural resources, migration, social stability and economic prosperity are different facets of an interconnected nexus that calls for collaborative efforts between EU and NAMEBA states. The success of such efforts relies on the development of a long-term structured dialogue between EU and NAMEBA states and the translation of this dialogue into meaningful actions. This has been pursued over many years now through the definition of joint strategies and the implementation of relative policies at national, regional or international level. The latter is realised through the mobilisation of several dedicated instruments (e.g. ENI, IPA), development programmes (e.g. official development assistance) and partnership schemes (PRIMA, the Africa-EU Partnership, etc.). Whilst these approaches have become the cornerstone of cooperation between Europe and NAMEBA, they are still to overcome overlaps and fragmentation, and to fully exploit key enabling technological tools. It is precisely in this context, that Earth Observation offers a significant capability for (near) real time provision of accurate information to policy makers, scientists, businesses and the public, enabling them to take effective actions in response to various environmental challenges and towards ensuring civil security.

2.2 Earth Observation in support of addressing key challenges

Earth Observation (EO) data and services can support the informed implementation of numerous policies, help in addressing key societal challenges, and boost economic growth. At the global scale, the most important contribution of EO comes in connection to the 2030 sustainable development goals agenda. The agenda is anchored by 17 Sustainable Development Goals (SDGs), associated targets, and a global indicator framework. Collectively, these elements enable countries and the global community to measure, manage and monitor progress on economic, social and environmental sustainability. To that end, the importance of data cannot be overstated; this is best captured in the dedicated report requested by the UN Secretary General in 2014:

"*Data are the lifeblood of decision-making and the raw material for accountability. Without high-quality data providing the right information on the right things at the right time; designing, monitoring and evaluating effective policies becomes almost impossible*".

In that respect, Earth Observation (EO) holds a prominent role. As stated in Art. 76 of the 2030 Agenda *"... We will promote transparent and accountable scaling-up of appropriate public-private cooperation to exploit the contribution to be made by a wide range of data, including earth observation and geo-spatial information…"*. The significant role of EO has been further underlined by the G7 Environment Ministers 2016 Communiqué on Climate Change *"We recognize the necessity of robust EO to enhance our ability to measure and monitor Greenhouse Gas (GHG) emissions".* Furthermore, the G7 Science and Technology

Ministers 2016 Communiqué Art. 6 on Open Science recognises that *"Fundamental to the progress of open science is the continued investment by governments and others, such as the Global EO System of Systems (GEOSS) of GEO, in suitable infrastructures and services for data collection, analysis, preservation and dissemination".*

Against this backdrop, the Group on Earth Observations (GEO) is leading several activities towards coordinated, comprehensive and sustained Earth observations. The EU – being the strongest contributor to GEO – is fully committed to maintain global leadership in this domain and promote the delivery of EO-generated benefits across multiple application sectors. Thus, recognising the role of EO as a driver for economic growth, the EU has reaffirmed its intention to reinforce EO capacities both inside Europe but also in its immediate neighbourhood. This is directly reflected in the recent Space Strategy for Europe, which foresees a host of actions centred around the continued investment in the Copernicus programme (€7B in the 2014-2020 period) and driven by the exploitation of Copernicus data and services in downstream markets. This includes *inter alia* efforts to *facilitate the use of Copernicus data and information by strengthening data dissemination and setting up platform services, promoting interfaces with non-space data and services* whilst also recognising the need for the *establishment of stronger links with the commercial downstream sector as being essential to develop tailor-made applications.*

The achievement of these actions will be pursued in the coming years through a series of interconnected activities. This entails further development of the Copernicus Services and targeted efforts for increased uptake of their products; building the Copernicus ecosystem of actors across academia, industry, and governmental organisations; nurturing the European innovation and entrepreneurial output through a range of acceleration and incubation programmes; and ensuring the development of a world-class cadre of scientists, engineers and technologists through the strengthening of Skills.

Alongside and directly supporting these activities, *EuroGEOSS* – a large-scale, user-oriented initiative launched at the end of 2017, aspires to combine and coordinate the outputs of Copernicus and previous GEO-projects towards a comprehensive European contribution to GEOSS, whilst at the same time maximising the benefits of EO for European society and economy.

The implementation of all these activities will be facilitated by the adoption of the recent EC proposal for an even stronger and more ambitious EU Space programme beyond 2020. Their success, however, is directly dependent on recognising and eventually tackling the challenges currently facing the EO sector in Europe and beyond.

2.3 Current Barriers in Europe and beyond

The realisation of the significant socio-economic and environmental benefits associated with the uptake of EO data and services is directly tied to effectively addressing a range of challenges and barriers. Thus, drawing on several key studies of the European EO market (EP, 2016; Innovate UK, Lomax Consulting & Catapult, 2018; EARSC, 2017; NSR, 2017; Smith, 2015; EC, 2013) we discuss below some of the most important challenges facing the EO sector today.

Fragmentation of the European market across Member States and sectors.

Today, the European and GEOSS EO landscape is fragmented and the various activities are not fully coordinated. The efforts of the European community for structuring this landscape are currently concentrated on access to data, tools and services, and infrastructure. These efforts are taking place at a time where there are still large differences across Member States on conditions that significantly complicate scaling of EO solutions both within and beyond European borders. Different legislations, regulations and guidelines require legal diligence and often slow down the adoption of EO for monitoring, management and reporting procedures. Different languages and work cultures often restrict the impact of international collaboration and hinder the ability of innovative SMEs to compete in local markets and

tenders. Also, different levels of maturity and EO capacity across sectors and countries affect the likelihood of users adopting EO solutions.

Low awareness of EO and its potential benefits in target sectors.

Whilst the focus of the EU on raising awareness among user communities on the various benefits of EO is ever increasing, there is still a long way to go to create a critical mass of operational cases of EO utilisation. This is best reflected in the work carried out under the Sentinel Economic Benefits Study (funded by the EC through ESA and executed by EARSC). Thus, even if over 100 cases of use of EO by users have been assembled in the 1st year of activities, very few of them had truly reached an operational maturity whereby the users where able to fully appreciate the EO-induced benefits and become recurrent customers. This is even more pertinent when looking at results of R&D projects (either RIA or IA actions) and the currently limited success of consortia to scale them up and exploit them in the real market. Thus, following years of **technology push**, the EO market today is still characterised by a **relative disconnect between the supply and the demand side**. This creates a systematic barrier whereby service providers and value-adders are developing innovative solutions whose market potential is not fully realised, and users are not fully exploiting EO services because they don't realise its potential.

Effective exploitation of Big Data

The market for EO data and services is currently undergoing a significant shift. This is driven by the **advent of the Big Data era**, spearheaded by Copernicus' free, full and open data policy but also by the **emergence of new EO business models** relying on large fleets of small satellites (e.g. Planet). This increase in satellites results in a massive increase of EO data; according to ESA, as of 2017, over one million data products are being generated under the Copernicus programme within one single quarter. At the same time, the commercial data market is projected to increase from $1.7 billion in 2015 to $3 billion in 2025**.** This huge amount of data presents an enormous opportunity for boosting productivity, innovation and competitiveness of European solution providers, especially in emerging industries such as food and energy, and in response to key socio-economic and environmental challenges. Yet, the **exploitation of Big Data is no simple task**; not only does it rely on easy and continuous access to data, but it also requires the availability of the appropriate tools (e.g. data discovery and integration, data visualisation, access to pre-processed data) and resources (e.g. cloud computing). To address this, the EC together with ESA have procured the Copernicus Data and Information Access Services (DIAS), which will provide easy, robust and continuous access to Copernicus, as well as cloud storage and computing resources to companies building EO services; today five DIAS' are being launched (sobloo, mundi, creodias, onda, wekeo). Whilst the DIAS' are still at a nascent stage at the time of writing, they carry strong promise to act as a significant lever not only for data access and processing but also for the stimulation of an EO ecosystem around them. Similarly, other efforts such as ESA TEPS, the GEOSS platform, NextGEOSS and even the activities connected to the European Open Science Cloud are striving to create traction with relevant communities, empower developers of solutions and unleash the potential of big EO data in different downstream sectors.

Lack of coherent data management practices, including different data standards, different data accessibility and lack of interoperability.

This issue makes it difficult to find and source relevant local data and expand EO solutions to new geographical areas. The issue can have roots at the policy level of organisations and even countries, but it is also manifested in practice in conditions of conducive policy – e.g. the presence or lack of a culture of open data sharing. Several efforts connected to the implementation of the INSPIRE directive and to the

promotion of GEO Data sharing and Data management principles are currently ongoing, but a lot remains to be done.

A lack of access to follow-up capital for commercialisation and further innovation of pilot results. Compared to their peers in the United States, European companies have less access to private funding, including venture capital, and public funding, which is needed to overcome the valley of death (i.e. initial deficit in cashflow during innovation and initial commercialisation activities). This is even more pronounced when looking at the NAMEBA region. Thus, very few companies achieve a true breakthrough into sustainable commercial activities. Furthermore, the **distinct lack of a sustainability driven culture** leaves a large part of the otherwise excellent **R&D efforts of EO actors under- or un-exploited**.

Skills shortage

Making the most of the increased investment of the EU in EO activities will require sustained efforts towards technological and scientific excellence, but also coordinated support towards "building the workforce of the future". In other words, **maximising the benefits of EO** for society and the EU economy, maintaining EU excellence in EO-related S&T, and nurturing the European innovation and entrepreneurial output, **requires a workforce that is expanded (in terms of numbers) and improved (in terms of skills)**. This need is well recognised in the Space Strategy for Europe; ensuring **the development of a world-class cadre of scientists, engineers and technologists** working in the Space sector becomes even more urgent as **35% of employees in the space-sector are aged 49-58 and are due to retire soon**[1]**.** In this context, the **Blueprint for Sectorial cooperation on skill** has been launched. It serves as the main tool to deliver sector-specific skills solutions under the New Skills Agenda for Europe. In this regard, the Blueprint connected to geo-information, is being realised through EO4GEO, a project looking into skills development and capacity building in the space geo-information sector in support of Copernicus User Uptake. The positive impact of the activities of EO4GEO and other similar actions is even more needed when looking at the NAMEBA region (see more in section 3.2).

2.4 The need for coordinated and sustained Earth Observations in the NAMEBA region

The role of coordinated, comprehensive and sustained Earth Observation information, as an enabler for informed decision making towards effectively addressing global and regional challenges, has been the keystone of the GEO vision. The key levers, as recognised in the 2016-2025 GEO Vision are: (i) the advancement of EO data sharing, (ii) greater EO interoperability and integration, (iii) substantial collaboration among governments and international organisations, (iv) empowered regional coordination, and (v) user-driven networks and projects to close critical information gaps.

In direct "dialogue" with this vision, the EU has been strongly contributing to GEOSS through the deployment of Copernicus but also through the funding (over €200M in the course of FP7) of the needed R&D constituents. In that context several projects have been implemented, with the aim to build the necessary EO capacities at national/regional level, engage the relevant EO players and develop synergetic approaches to research and EO service development. This has been also strongly informed by the recognition of EO's role as a key driver for smart specialisation strategies at the regional level.

[1] ASD-EuroSpace, 2018. Data from an unpublished paper.

Yet, despite all these efforts, at the time when GEO-CRADLE was starting (2015), several critical gaps existed in the NAMEBA region. Ironically perhaps, the gap in knowledge about what the gaps are, was a critical barrier for any effort towards coordinating EO activities. Thus, building on outputs of key projects (e.g. BalkanGEONet and AfriGEOSS), as well as the conclusions of dedicated events such as the 2nd South-Eastern Europe GEO Workshop (October 2014)[2] and the 8th GEO European Projects Workshop (June 2014)[3], organised by NOA, we were able to note:

- A disparate level of development w.r.t to community building and networking in the different countries, coupled with the ineffective exploitation of available complementarities in resources and expertise, the lack of strategy and knowledge of processes for international integration and cooperation, the bottom-up approach and self-targeted implementation of activities at the institutional level and the fragmented coordination of different observational and computational platforms.
- The ineffective engagement of the user community and stakeholders in the region, the low involvement of industries, SMEs and other key players and the limited public awareness on the benefits that EO can bring to the market and into people's everyday lives.
- The identification and exploitation of synergies in terms of funds, capacities and research disciplines, co-ordination of data and infrastructure, operation of common facilities and joint exploitation schemes, and a gradual adjustment towards stakeholder needs who will be convinced with hands on illustrations.
- The clear gap between the northern and the southern nations of the Mediterranean basin that affects to a great extent the research outputs in terms of validation and coherency, and the transformation of the regional capacities to sustainable services following the paradigm of Copernicus.

To tackle these challenges, the need for a permanent coordination mechanism at the regional level, building interfaces with GEO and EU, but also other initiatives like AfriGEOSS, was highlighted. Such a "structure" should provide an effective means to promote collaboration between countries with proven capacity in the field, to foster the exploitation of best practices by potential new GEO members (e.g. using the experience of the Greek GEO office, one of the few regional offices in the world), and eventually to act as a springboard for the implementation of GEOSS and Copernicus in the region of NAMEBA.

This need gave rise to the GEO-CRADLE project, which has since strived to live up to its main aspiration:

To constitute the "*cradle*" of sustainable, coordinated EO activities and capacities in NAMEBA, through the maximisation of synergies amongst key EO partners and the creation of an ecosystem and a toolbox that allows to effectively address the regional needs within and beyond the project's lifetime, supporting the implementation of GEOSS and Copernicus.

[2] http://ocean.space.noa.gr/BEYONDsite/index.php/2nd-se-geo-workshop-home
[3] http://www.gepw8.noa.gr/index.html

2.5 Knowing the "now" is the key to shaping the "tomorrow"

So, with 3 years of intensive collaboration and coordination activities under our belt, we find ourselves in a position where we can more securely attempt to answer some key questions:

- **Where are we now?** What is the current state-of-play with regards to EO activities in the NAMEBA region? What challenges is the region still facing? What is the footprint of GEO, GEOSS, Copernicus and other international activities?
- **Where do we want to be?** What is the future we are trying to shape and what is the role of EO in it? Where do we want to direct investment to?
- **How can we get there?** Which actions shall we undertake as an EO community to support informed decision making in this region? Which collaborative activities shall we carry out to achieve the desired future we envisage?

Providing well-justified answers to these questions is the purpose of this roadmap. The next chapters lay out the findings from the analysis of a wealth of data collected throughout the 3 years of GEO-CRADLE implementation. But before we go on we must recall the methodology used throughout the project to allow us to be in a position today, where we can seek evidence-backed answers to these questions and, subsequently, draft a meaningful roadmap for the future implementation of GEO and Copernicus.

2.6 Methodology to build the roadmap

The methodology we have followed to develop this roadmap, relied on **three main steps** shown in the middle box of the figure below and explained in more detail in the following.

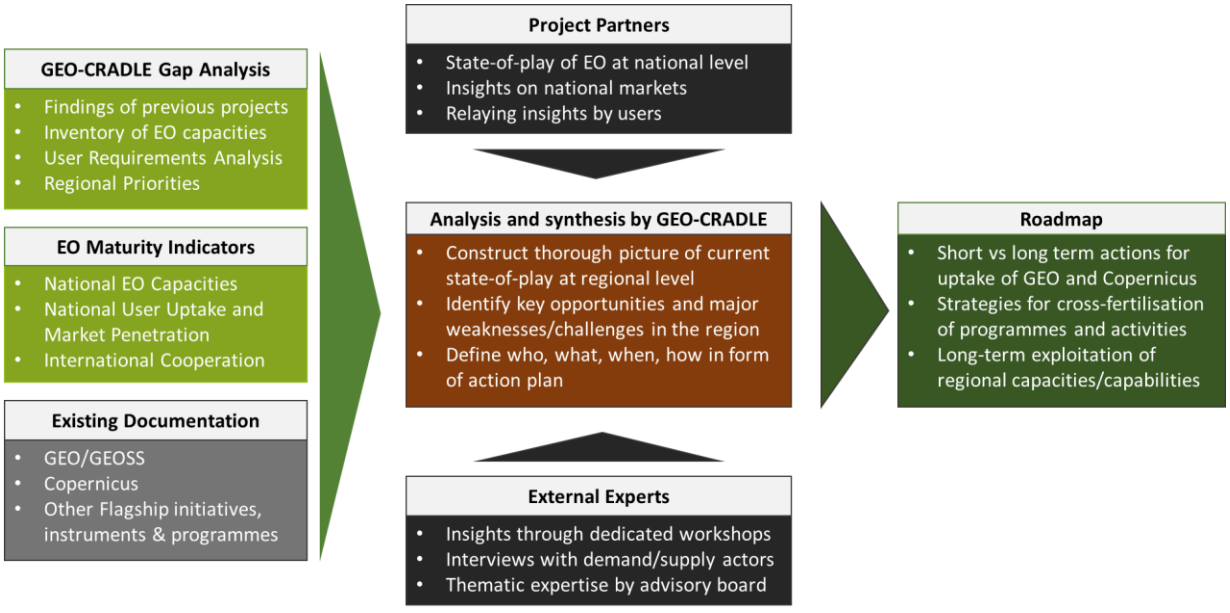


Figure 1: GEO-CRADLE Methodology for the development of the Roadmap

2.6.1 Constructing a thorough picture of the current state of play

One of our primary concerns from the beginning of the project has been to construct a thorough picture of the current state of play in the NAMEBA region. This knowledge would then allow us to design and implement impact-driven actions both during and after the project's lifetime. Thus, we started by elaborating an **inventory of capacities** with 10 fields that included:

- Existing **space-borne capacities** in the RoI, covering existing EO Payload Data Ground Segments and related national, Copernicus, and Contributing satellite missions;
- Available **ground-based / in-situ monitoring networks / facilities** in the RoI, utilising the knowledge base provided by EGS and consortium partners operating such networks;
- Overview of **modelling and computing processing capacities**, recording the available capacities in that regard both nationally and regionally.

Overall the capacities of 192 stakeholders from 29 countries are now available online on the GEO-CRADLE Networking Platform, as shown on the Figure below.

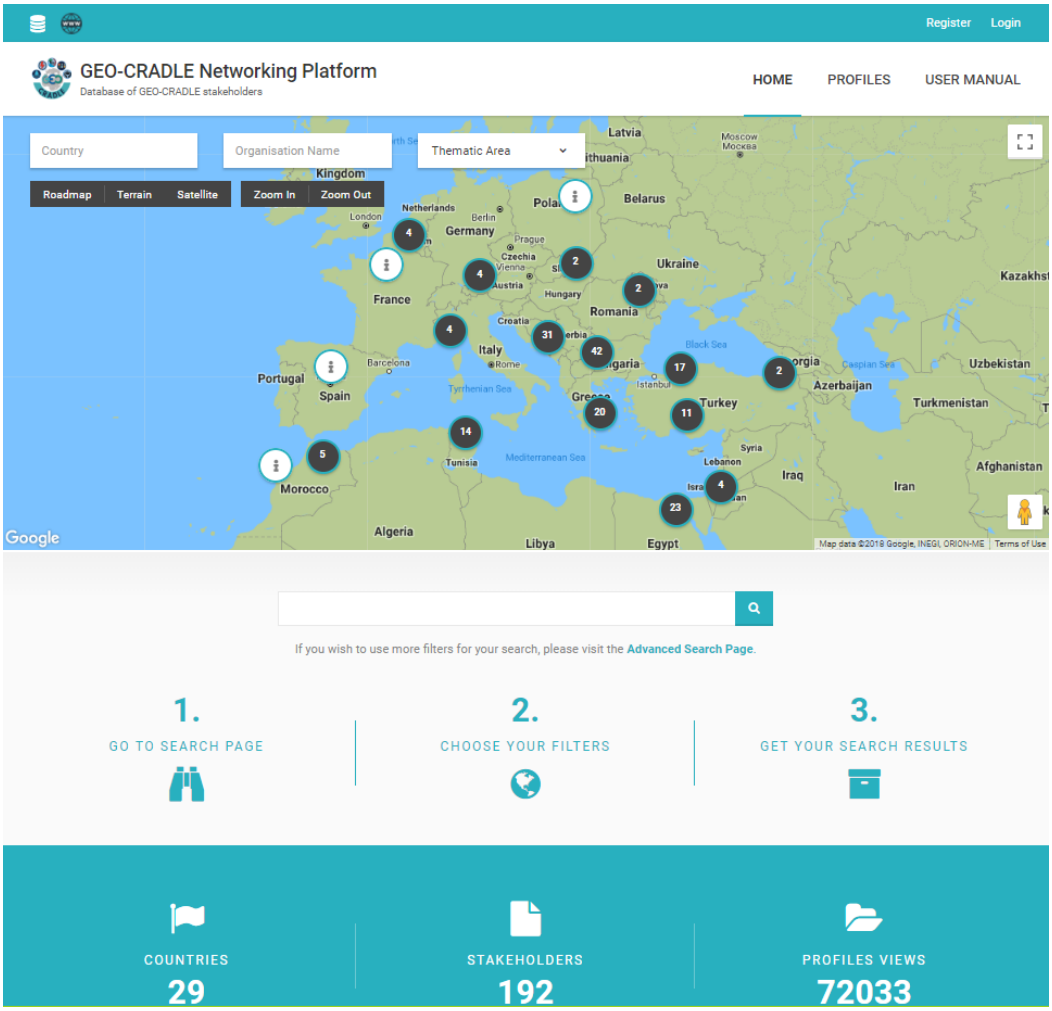


Figure 2: The GEO-CRADLE Networking Platform

The elaboration of the inventories was carried out by exploiting, consolidating and extending (both geographically and w.r.t. to sophistication) available databases (e.g. from BalkanGEONet and Iason), while

applying specific focus on highlighting interoperability and complementarity of the different items. This was complemented by an extensive mobilisation of the GEO-CRADLE consortium partners – each representing a prominent EO player in their respective countries. Thus, by leveraging their knowledge of the local ecosystem, their network in these countries and reach to key actors across the value chain, we have been able to compile a representative picture of the current state of play in each country.

In In parallel, and under the leadership of EURISY - who have a concrete mandate of bridging the different stakeholder communities (end-users, policy makers, service providers, scientists) – we carried out an extensive **user need analysis**, covering both vertical (e.g. data accessibility and interoperability, funding opportunities,) and horizontal (i.e. across different application segments) issues (User Need Analysis Survey. In total 93 exploratory interviews from 14 countries (Serbia, Romania, Bulgaria, FYROM, Albania, Greece, Cyprus, Morocco, Tunisia, Egypt, Israel, Saudi Arabia, United Arab Emirates and Turkey) were analysed, which explored the bottom-up demand of geoinformation services for end-users relevant to the thematic priorities covered by the project in the NAMEBA region (User Need Analysis Report I, User Need Analysis Report II).

With this fresh knowledge at hand, we then set out to execute an in-depth **gap analysis** looking into the existing EO capabilities vis-à-vis the requirements of users across the countries of the region. This gap analysis has served as a guide for the definition and implementation in 11 countries (Albania, Bulgaria, Cyprus, Egypt, FYROM, Greece, Israel, Romania, Serbia, Tunisia and Turkey) of the novel **EO Maturity Indicators Methodology** (see box and figures below).

Developing and implementing the novel EO Maturity Indicators Methodology

GEO-CRADLE has proposed 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.

Using the findings of the gap analysis and the insights provided in the form of country maturity cards, we were able to extract priorities against regional challenges (see chapter 3 for details). As a first tangible step towards addressing these challenges, GEO-CRADLE designed and implemented a set of activities focussing either on building capacities (i.e. via the **GEO-CRADLE Networking Platform** and the **Regional Data Hub**) or on piloting services related to **adaptation to climate change**, **improved food security and water extremes management,** better **access to raw materials**, and better **exploitation of renewable energy sources.** Lessons learned from the implementation of these activities are also fully embedded in the analysis leading to the roadmap here.

2.6.2 Identifying key opportunities and major weaknesses/challenges

When considering the short – to – long term actions that will help to untap the potential of EO as a tool supporting informed decision making in the region, we need to fully take into account **strengths, weaknesses, opportunities and threats**. In this regard, maintaining an accurate picture of the current state-of-play around EO activities as well as monitoring its evolution is a dynamic process. It requires regular updates and relies on continuous osmosis between the different actors in the EO value chain and beyond it (i.e. non-traditional actors). To that effect, GEO-CRADLE has organised a series of regional workshops and dedicated side sessions during flagship events (see Annex 1). These events offered a prime opportunity to exchange with various stakeholders representing the national, regional and international EO ecosystem. Combining the outputs and conclusions of these events with the insights gathered through a wide range of dedicated interviews with demand and supply side representatives, we have been able to pinpoint current and future opportunities in the region and to evaluate the major weaknesses/challenges that act as blocking factors for the realisation of such opportunities. These are typically informed by a combination of **top-down** and **bottom-up effects**. The former is dictated by the strategic orientation of flagships such as Copernicus, GEO or non-EO-as-such programmes (e.g. PRIMA, ENI, etc.). In contrast, national or even regional initiatives are often disconnected from the greater picture even if they form a significant part of it. Therefore, our aspiration when defining actions that form part of this roadmap was to reconcile these two sides. In practice, this entails tailoring of the GEOSS and Copernicus implementation strategy to regional, national and local needs (top-down), but also fostering the coordination of national and regional activities and their linkage to the greater strategic view of GEO and Copernicus (bottom-up). The result of our synthetic approach is presented in a dedicated SWOT diagram at the end of chapter 3.

2.6.3 Defining who, what, when, how in the form of an action plan

Our aim and hope is that the final output of this effort will be truly actionable, i.e. enabling the involved actors to take meaningful action towards maximising the benefits of EO in the region, and not prompting them instead to lock this report in a drawer. To that end, we have adopted a rather direct approach defining in very clear terms **who should be involved**, **what should they focus on, how shall they go about implementing these actions and in which timeframes (when).** These elements are combined in the form of an action plan that should be considered a "living" document. This action plan takes into account potential "low-hanging fruit" or "quick wins" vs. longer-term perspectives; it also provides a baseline for the elaboration of strategies that promote the effective cross-fertilisation of programmes and activities. Finally, it offers a sense of our vision for longer-term exploitation and strengthening of regional capabilities and capacities.

2.6.4 Navigating inside the document

Readers wishing to understand the "today" of EO activities in the NAMEBA region are advised to study the next chapter entitled "Where are we now". Chapter 4 "Where do we want to be" bridges this overview of the current state-of-play with the destinations reflecting the desired progress in the region. Chapter 5 is, by construction, the most "actionable" part of this document, as it presents in concrete terms what can be done to achieve the envisaged future of EO activities in NAMEBA.

This image of the Karavasta Lagoon in Albania is a subset from the first acquisition by Sentinel-2B on 15 March 2017. Released 15/03/2017

3 Where are we now?

3.1 Maturity of Earth Observation activities in NAMEBA region

The first step towards producing a roadmap for the future implementation of GEOSS and Copernicus in the NAMEBA region, entailed the construction of an accurate picture of the current state of play. As briefly introduced in section 2.6, this started with the elaboration of a thorough inventory of existing EO capacities, the execution of a deep dive into user needs in the region and the comparison of the two in the framework of a gap analysis (EO activities vs user needs). The outputs of the gap analysis fed into and were further solidified by the design and implementation of the novel EO maturity indicators methodology. The latter has helped us to structure the answer to the "where are we now" question along three main axes:

- **Cooperation on EO activities:** Our aim here was to understand the extent to which EO activities in each country are well coordinated and the degree of each country's involvement in international collaboration around EO.
- **Current EO capacities:** This entails a more focussed look on the structure of the value chain (public organisations, academia, industry) and in particular the strengths and weaknesses of the various links (e.g. infrastructure, scientific output).
- **National Uptake and Awareness:** The ultimate aim of EO is to support informed decision making across different sectors. Thus, it is critical to understand to what extent EO is used in support of national or international policy priorities, whether dedicated capacity building actions are implemented, and if dedicated budgets are deployed for such activities.

Thus, our objective was to understand the maturity of each country in relation to these three axes, whilst also studying the footprint and impact of key international activities in the region. But before we enter into the details of each of these topics it is instructive to briefly discuss the bigger picture for EO activities in the region.

3.1.1 The big picture

NAMEBA is a diverse region characterised by **distinct differences** between the various countries but also marked by **cross-border trends** and **commonalities.** Several of the countries in the region have recently experienced geo-political instability or financial recession; some are just now recovering from recent crises whilst others are still entangled in them. This in itself has had a major impact on the continuity of investments in Earth Observation activities, especially since the public sector has a central role in driving EO in the region. Thus, countries such as Greece have recently experienced significant budgetary cuts on EO-related activities due to the overall financial crisis, whereas others such as Egypt have significantly reduced their expenditure in national space programmes as priorities had been shifted. Nonetheless, both countries hold relative leadership in EO activities in the Balkans and North Africa respectively, thanks to their long-standing involvement in various international programmes. In parallel, Bulgaria and Romania have been seeking to make the most of their relatively recent joining of the European Union and their strong connection to ESA. Similarly, Serbia, Turkey and Albania have been in the process of increasing

their overall EO output in close correlation with their status as pre-accession countries. Tunisia and Cyprus have been developing good sectorial capacities, whilst Israel has been maintaining a well-balanced EO agenda. Finally, FYROM is making its first decisive steps towards better exploitation of EO data and services.

At the same time, the region is facing several cross-border challenges that call for intensified efforts in the exploitation of EO data. Climate change, water scarcity, natural resources overexploitation, threatened food security, population growth and migration are some of the common challenges affecting the countries in the region. Addressing them has progressed at varying levels from country to country, with some already committing significant parts of the national budget and actively subscribing to relevant international frameworks (e.g. 2030 Agenda for Sustainable Development) or partnerships (e.g. PRIMA).

This combination of commonalities and differences is an important factor when considering the design of future EO actions across the countries of the region. This fact was captured very well during the 3 years of the GEO-CRADLE activities. Thus, the strengths and weaknesses of the national EO ecosystems were readily communicated by the multitude of actors engaged in the many regional workshops we have organised in the region. Needs for improved capacities, greater awareness and intensified collaboration were highlighted time and again from representatives of different parts of the EO value chain. Yet, moving from the qualitative to the quantitative understanding of the pulse of EO activities in the region requires much more than these exchanges. To that end, we have developed and studied a very extensive set of EO maturity indicators[4] through the corresponding methodology pioneered in GEO-CRADLE (see figure below).

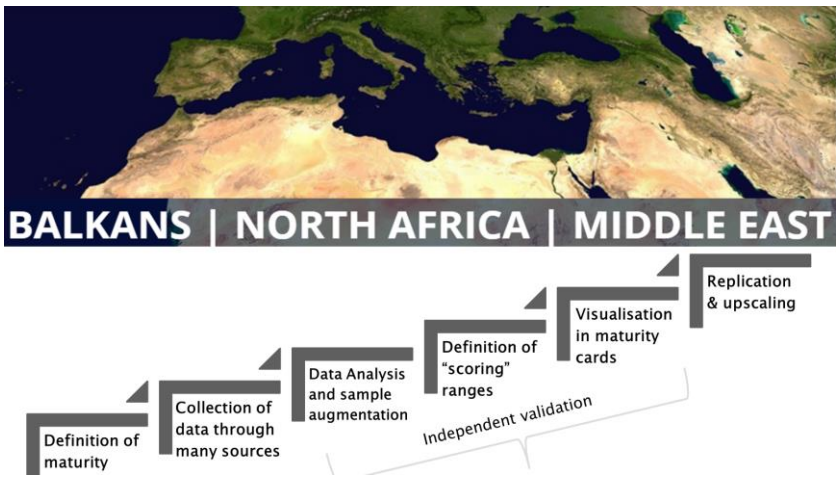


Figure 3: The GEO-CRADLE Maturity Indicators Methodology applied in NAMEBA

[4] A summary of the findings of the EO maturity indicators approach is provided in a dedicated paper that was published in October 2018. The detailed account is provided in the relevant deliverables D3.2 and D3.4 which are publicly available on the Deliverables section of the GEO-CRADLE website.

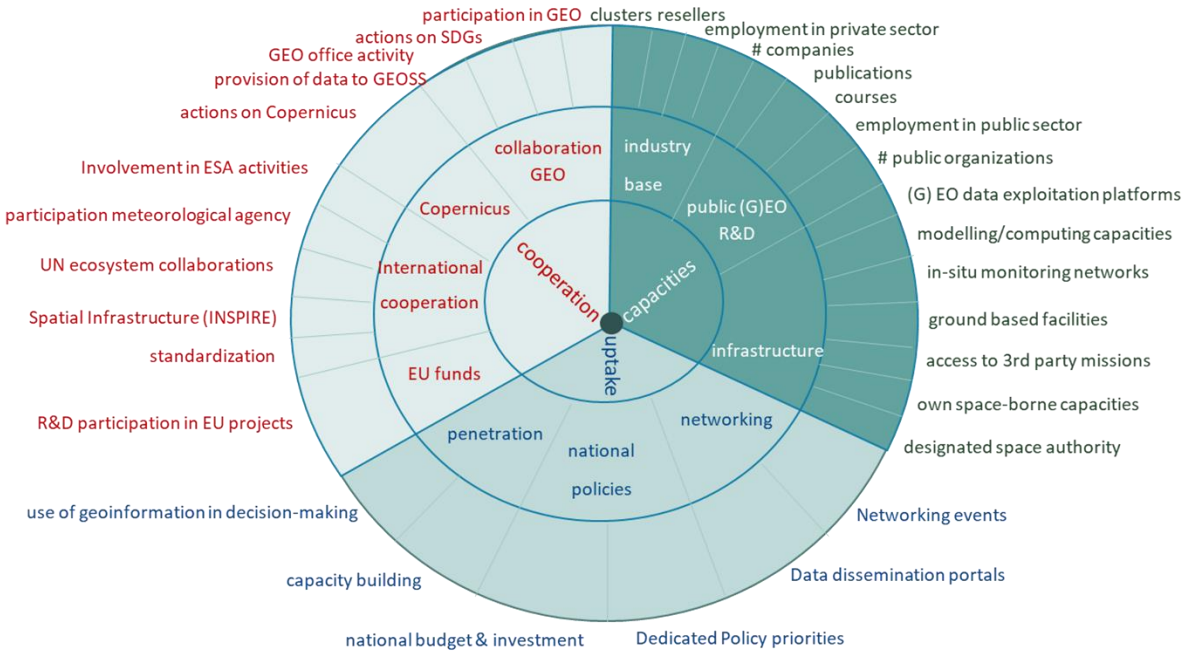


Figure 4: The various indicators studied in order to establish the levels of EO maturity in the NAMEBA region

Looking at the performance of each country against the combined sets of indicators we get the diagram below.

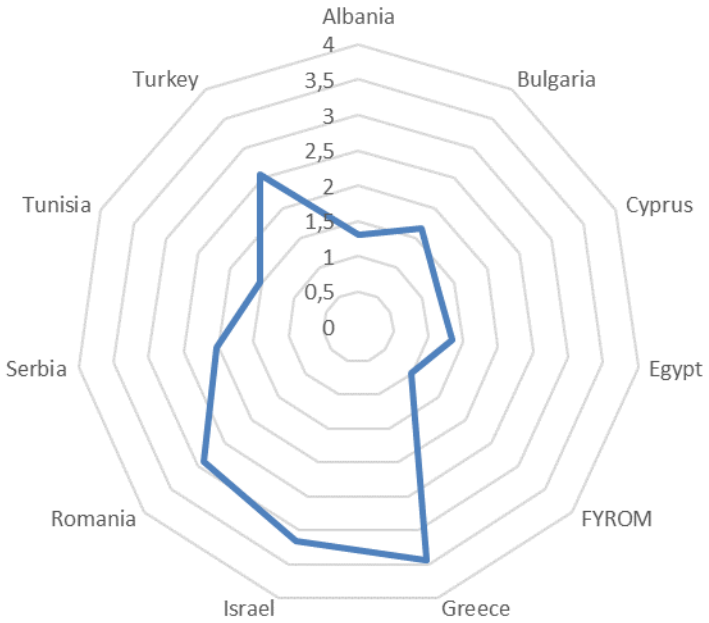
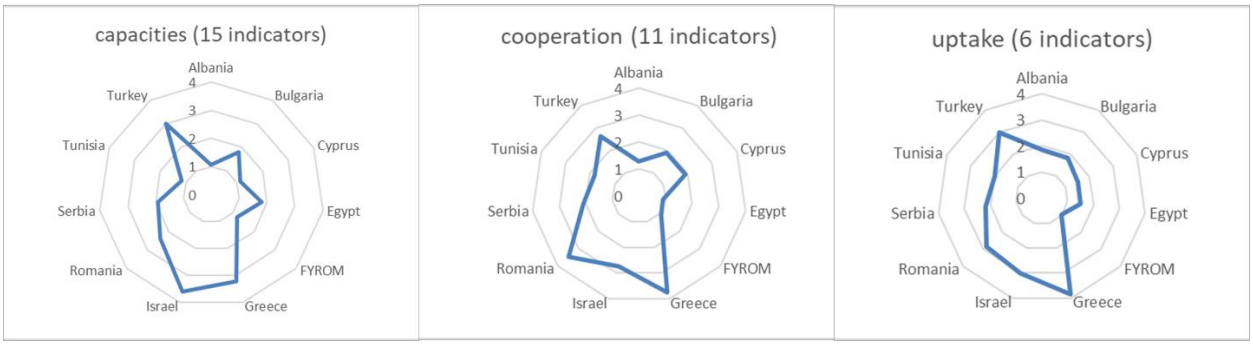


Figure 5: The overall maturity score for countries surveyed by the GEO-CRADLE project in the Balkans, Middle East and North Africa

Breaking this high-level overview across the 3 main categories we get the following pictures:



These results allow us to make some first observations:

- Countries with a designated Space authority (Space agency or other) and tight links to ESA tend to have better coordinated capacities
- Countries with long-term involvement in Copernicus or GEO tend to rank higher in cooperation and uptake
- The EO sector develops as a system, wherein investments and connectivity among the actors in the ecosystem drive its overall maturity

Equipped with these first insights of the current state of play in the region let us have a deeper look for each of the three aforementioned axes[5].

3.1.2 Coordination of EO activities

GEO-CRADLE is a coordination and support action that has been put forward by the European Commission to fill in a perceived gap in the region. The SC5-18b-2015 topic which gave rise to this project, was calling for actions that will help in *"integrating, coordinating and supporting initiatives in these countries to deliver Earth Observation information services that will benefit critical sectors"*. But has this perception been confirmed? Does the region lag behind in terms of coordination of EO activities at national level and of involvement in international programmes? The answer is a qualified yes. Let us dive into the details of that, using the main insights from the targeted gap analysis we have performed and the subsequent EO maturity indicators approach.

In the **Balkans**, the EU has exerted a large influence on the development of the EO sector in the past two decades. There is evidence in the results of the gap analysis that membership, beyond the accession process, greatly empowers this development. Nonetheless, whilst countries such as CY, RO, GR and BG perform well in terms of international cooperation, their respective EO ecosystems are often fragmented with relative disconnect between the various links of the value chain. Thus, even in the most advanced countries phenomena such as ministries not cooperating on data sharing are often observed. In the **Mediterranean countries of North Africa and the Middle East** included in the gap analysis, development

[5] For a detailed account of the current state of play in the region we invite the reader to access the GEO-CRADLE Gap Analysis and the Priorities Action Plan.

of the EO sector was mostly endemic. Israel is a special case in this region, as it has developed a very advanced EO sector. In comparison, Gulf countries have a shorter history of space-related activities, but one marked by rapid growth. What is observed essentially across the board is a growing level of cooperation between research and institutional actors, whilst the end-users and the industrial players are less interwoven in the greater fabric of the EO ecosystems. This lack of integration within the EO value chain has been generally observed; yet, in certain sectors of critical importance (e.g. food security, disaster management) a better situation has been documented. Another widespread observation is that of overlapping capacities, owing to a large extent to limited coordination between governmental organisations. Thus, in several countries (FYROM being perhaps the most prominent example), overlapping in situ capabilities between different institutions have been observed.

Another trend observed essentially across all the countries examined in GEO-CRADLE, is that coordination within the national EO sector in a country is to a large degree driven by the initiatives of a single, or multiple key organisations, whether this is a designated space agency (e.g. Romania and Israel), a Ministry (e.g. the Ministry of Higher Education and Scientific Research in Tunisia), or a Committee (e.g. the Hellenic National Space Committee founded in 1990s to coordinate and support development of the EO sector). In such cases, the annual organisation of dedicated EO workshops is commonplace, often in collaboration with international agencies such as ESA.

Finally, the influence of projects cannot be underestimated. As perfectly exemplified by GEO-CRADLE itself, international cooperation between leading EO organisations is key to accessing EU funding (e.g. ESA tenders, H2020) which further strengthens the EO sector and insulates it from consequences of cyclical budgetary cutbacks. Similarly, pre-accession funds, structural funds and other support actions (e.g. World Bank activities) have had a significant impact in Western Balkan countries (RS, MK, BG, AL). Twinning activities (e.g. RO and CY) also tend to have an important role in building the overall EO value chain at national level. Nonetheless, in most cases projects are not sustainably followed up with national commitment.

3.1.3 Current EO capacities

GEO-CRADLE has attempted to construct an accurate picture of the current EO capacities in the region. This concerns aspects such as the presence of a designated space authority (in connection to coordination of EO activities too), the quality and scale of technical capacities and infrastructure (e.g. in situ networks, ground-based facilities, own space-borne assets, modelling capabilities, data exploitation platforms, etc.), the overall scientific output (e.g. number of publications and courses related to EO), the maturity of the private sector (e.g. number of companies, employment figures, existence of clusters, etc.).

The results of this analysis highlight clear gaps between but also within the countries. Thus, we observed stark differences when it comes to how advanced national EO-related infrastructure is. Countries such as Greece, Israel and Turkey have relatively advanced and balanced capacities in this regard, whereas the rest of the region is some (or several) steps behind. Taking a closer look into that, we see that all three have well-developed in situ networks and ground-based facilities, as well as good access to EO data and associated exploitation platforms (e.g. Greece is strongly connected and contributing to the Copernicus

Ground segment, operating *inter alia* the Hellenic Copernicus mirror site). On the other hand, several other countries in the region have limited capacities even to more basic aspects such as good internet connection allowing meaningful manipulation of EO datasets. It is also important to note that whilst some countries have been developing their capacities in close connection to international bodies (e.g. Greece and Romania in connection to ESA), others have to focus on nationally-driven efforts. For example, Israel and Turkey have invested in small satellites due to high costs of satellite programmes, with Israel being globally recognised as a pioneer in this regard.

In addition to the heterogeneity between countries in the RoI, there is also a marked difference in the capacities between different sectors within a country. Most notably, meteorological and climate capacities tend to be relatively advanced in the RoI across all the surveyed countries, with dedicated institutions using satellite data, operating in situ networks, owning computing facilities and even developing climate models. On the other hand, EO capacities for soil attributes and energy and radiation activity areas were much more limited, with significant capacities only recorded in countries found to have a more mature EO sector.

When it comes to the maturity of the different links of the value chain in the countries of the RoI, we observe important commonalities. Thus, in most countries the EO sector is dominated by public sector bodies, whereas the private sector is at best closely tied to public tenders/procurement and at worst non-existent whatsoever. In contrast, the academic sector is performing at a higher level, with several countries have a critical mass of EO researchers, designated EO courses and a large volume of publications. Moreover, advanced modelling capabilities in specific sectors (e.g. climate, atmosphere, hydro-meteo) are clearly present across several countries in the region. This disconnect between scientific and entrepreneurial output is not endemic to the NAMEBA region; but is certainly more pronounced compared to that of the EU for example.

Closely associated with the level and the continuity of EO capacities are two important phenomena that apply to varying degrees across the countries of the region. The first is connect to funding: this can often be the largest barrier to maintenance and further development of capacities. As an example, Greece had stopped for several years its participation in the optional EO programmes of ESA. Similarly, in Cyprus the Research Promotion Foundation had frozen funding of projects for over 5 years. In FYROM, in situ capacities have been failing due to discontinued funding as well. The second capacity-related barrier is connected to human capital. Several countries are reporting lack of human resources in terms of adequate training and relevant skills (e.g. Albania, Egypt, Tunisia), whereas others have recently experienced unprecedented brain drain (e.g. Greece, Bulgaria, Romania, Serbia). In parallel, the Gulf countries often suffer from “ephemeral” workforce, that is “western” highly-skilled workers who join EO-related programmes for a few years but then move again out of the country, often causing discontinuity.

Recognising this overall situation several countries have shown tremendous “thirst” to participate in capacity building and knowledge transfer activities. In fact, technical and financial support from the EU and other donors for capacity building in public institutions and for projects that use EO was seen to be a significant lever for progress of EO maturity. Prime examples for that are Centres of Excellence established in Serbia (ANTARES), Greece (BEYOND) and possibly in Cyprus (EXCELSIOR); similarly twinning projects

(e.g. GR and RO) and cross-border collaboration (e.g. BG proposal on regional TEP in the Balkans and beyond) are considered particularly impactful towards strengthening and/or maintaining capacities.

3.1.4 National Uptake and Awareness

National uptake and awareness of EO solutions varied greatly among the different NAMEBA countries. This is directly tied to the overall circumstances and ecosystem capacity within each country. Thus, those that are already a member state of the EU/ESA have had an increased exposure to EO networking events. For example, ESA, but in recent years also DG GROW as part of its Uptake Programme, organise dedicated EO workshops annually – often oriented to the country interests. In the NAMEBA region, the most regular events are in agriculture, land/forestry and crisis management domains.

Beyond the generic notion of uptake and awareness, it is important to understand to what extend different players in the value chain are actually using EO either in operational cases (from the users, policy makers point of view of usage) or as a tool to develop services (i.e. industry and when applicable scientists). This discussion also finds geographically driven discrepancies. Thus, in the **western Balkan** countries there is a tendency from some private companies as well as NGOs to use satellite images in their studies and projects, yet much less in operational market-oriented services. This is even more pronounced in the North Africa and Middle East regions. Still one of the major problems seems to be the lack of awareness of the larger EO picture. Basically, it has been noted that the partnership between research institutions / private sector and decision makers for EO data development and implementation could be improved in the region and that is subsequently indirectly reflected on the uptake of the EO services.

When it comes to the link of EO data uptake with the mentality of data sharing, many countries are making good progress – yet there is a still a long way to go towards full exploitation of EO. Examples for that include **FYROM** with its Biodiversity information system, **Turkey** with its spatial data information system, **Serbia** with the NSDI portal or **Greece** with its cadastral portal.

At the same time, the countries studied in GEO-CRADLE have been showing significant progress in relation to their “institutional capacity building”. This essentially entails the creation of an environment conducive to the use of EO for informed decision making. This is more prominent in mature countries in the region. On the other hand, less mature countries focus on education and training of individuals to be aware of, access, use and develop EO data and products. Yet, this is often organised in a rather *ad hoc* manner and not directly tied to well-defined governmental budget lines. The resulting “void” is to a large extend filled by activities spearheaded by Copernicus – in fact, this is generally seen as a game-changed in the region, especially when supported by regular uptake efforts.

The keyword here is “sustainability”. Thus, for the continued evolution of the use of EO solutions in key application areas such as health, tourism, agriculture, cultural heritage, transportations, sustainable development, etc., a sustained engagement of the ecosystem is highly needed in the region.

3.2 The footprint of international and national initiatives

The preceding discussion on the maturity of EO activities in the NAMEBA region is closely tied to the footprint of international and national initiatives. Thus, the sustained implementation and uptake of GEO/GEOSS and Copernicus but also the impact of other initiatives is critical towards strengthening the EO activities in the region. In this section, we provide an overview of the most important initiatives.

3.2.1 Current implementation of GEO/GEOSS

Back in 2002, the World Summit on Sustainable Development (WSSD), held in South Africa, highlighted the need for coordinated observations relating to the state of the Earth. One year later, during the First Earth Observation Summit (EOS-I) in Washington DC, 34 governments adopted a declaration establishing the *ad hoc* intergovernmental Group on Earth Observations (*ad hoc* GEO), and assigned the synthesis of a draft 10-Year Implementation Plan. The Third Earth Observation Summit (EOS-III) held in Brussels in 2005, resulted in delegations from almost 60 countries endorsing the 2005-2015 GEOSS 10-Year Implementation Plan and established the intergovernmental Group on Earth Observations (GEO) to implement it. Since then, GEO and GEOSS have undergone a snowball effect type of evolution, in terms of governance, mandates definition, targets and impact, peaking with the recognition of the need to reach consensus on the implementation of a set of Data Sharing Principles for GEOSS (First GEO Ministerial Summit, 2007, South Africa), a decision that still drives the functioning of GEO and its activities. Recognition of the necessity of geospatial information for sustainable development policy making and the crucial role of GEO to implement this, was built gradually. The UN Conference on Sustainable Development (UNCSD, Rio+20, 2012, Brazil) was the first UN convention to include GEOSS in its conclusions. A decade after GEO/GEOSS birth, it is currently a partnership of 105 national governments and 127 Participating Organizations that "*envision a future where decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observations*" and a clear mission to "*connect the demand for sound and timely environmental information with the supply of data and information about the Earth.*"

> The Mexico City Ministerial Summit Declaration, affirmed that GEO and its open EO data and information will support the implementation of, *inter alia,* the SDGs, the Sendai Framework for Disaster Risk Reduction 2015-2030, the UN System of Environmental and Economic Accounts and the UN Framework Convention on Climate Change.
>
> *Fourth GEO Ministerial Summit, November 2015, Mexico City*

As a global initiative, GEO has focused its geographical spread and Work Programme (WP) Implementation through the engagement of member states (expanding to Participating Organizations and Observers), and secondarily, but equally important, through the implementation of concrete activities realised via Flagships, Initiatives and Community Activities. In 2018, the special role that Caucus-established GEOs, namely AfriGEOSS, AmeriGEOSS, AOGEOSS and recently EuroGEOSS, has emerged, and their positioning in GEO WP is undergone. GEO-CRADLE commenced as a regional coordination project and has now

evolved into a GEO Initiative, with geographical characteristics still decisively underpinning its implementation. For this, the current state of GEO membership and indicative cross-section with activities of the Regional GEOs or along the GEO WP in the NAMEBA region, is further elaborated below.

Current gaps and GEO strategy to recruit members

The current state of the implementation of GEO/GEOSS in the NAMEBA region arises from the membership of individual countries in GEO's member list. The current mapping of GEO memberships is as following:

- **Balkans:** There are currently five (5) GEO members (Bulgaria, Croatia, Greece, Romania, Serbia) while the following countries have not yet joined: Albania, Bosnia and Herzegovina, Montenegro, Kosovo, FYROM.
- **North Africa:** There are currently four (4) GEO members (Algeria, Egypt, Morocco, Tunisia) while the following countries have not yet joined: Libya
- **Middle East:** There are currently six (6) GEO members (Bahrain, Cyprus, Israel, Oman, Turkey, UAE) while the following countries have not yet joined: Iraq, Jordan, Kuwait, Lebanon, Qatar, Saudi Arabia, Syria, Yemen

Figure 6: Map of GEO Members in the NAMEBA region[6]

Several Participating Organizations (POs) have their registered offices in NAMEBA (e.g. ASREN: Arab States Research and Education Network, CEDARE: Centre for Environment and Development for the Arab Region and Europe, CRTEAN: Regional Center for Remote Sensing North Africa States, i-BEC: Inter-Balkan Environment Centre, MKF: Mariolopoulos-Kanaginis Foundation for the Environmental Sciences, OSS: The

[6] Compiled from GEO's site in April 2018

Sahara and Sahel Observatory), while many others implement activities that are closely related with this region.

Observing the global picture, gaps in GEO membership are quite apparent in the NAMEBA region, and in response to this, the efforts of GEO (mainly through the GEO Secretariat, Regional GEOs, regional POs and projects) are focused on further engaging with these countries. The approach of GEO as reflected in its Secretariat plan of actions, aims at securing a first level of awareness on what GEO is and which are the benefits from joining. The means to implement the overall strategy are simple, yet necessary, given the low maturity reference point of the countries in the NAMEBA region, and include interaction with representatives of the countries in different international fora and conferences, more dedicated working meetings in the country, and the exchange of basic information packages about GEO, e.g. the GEO Strategic Plan, model letter to join GEO. Ideally, an endorsement at high national political level is pursued, followed up by the designation of a GEO PI and gradually by the establishment of a national structures, reflected to a national focal point or a more dedicated GEO Office (as is the case of Greece).

Within the tasks of GEO-CRADLE on "Regional Contribution to GEOSS & Copernicus", the Liaison Office of GEO-CRADLE (coordinated by the Greek GEO Office), encompassing targeted actions by the Project Coordinator, the Liaison Officer and the Regional Coordinators, undertook the duty of triggering and facilitating the creation of national GEO focal points in the NAMEBA region.

In November 2018, a **GEO Office was established in Albania**, as a result of the aforementioned activity of the project. The contact point has been designated at the State Authority for Geospatial Information (ASIG) by the Ministry for Europe and Foreign Affairs of Albania.

In recent years, there has been a shift to the strategy of engaging more member states, and efforts are rather concentrated on improving the connection of GEO within the country, with ministries and competent bodies that act as focal points or thematically address GEO priorities and SBAs. In this context, different catalogues have been developing, driven by the GEO Secretariat, and the new challenge is to build a complete, to the extent possible, picture of the local ecosystems and create a mechanism that ensures regular updates of information and appropriate mobilisation of resources. The feedback record from GEO PIs has always been and still is a drawback in the process, potentially calling for new, structured and more efficient interfacing to be put in force.

Global GEO activities relevant to NAMEBA

Indicative examples of activities undergone within GEO Flagships, Initiatives, GEO PO workflows, are presented here.

AfriGEOSS: Reinforcing Regional African Engagement, is a Regional GEO Initiative which includes 4 countries in the NAMEBA region (Morocco, Algeria, Tunisia, and Egypt), and includes Morocco in its contributing members. Its goal is to "*provide the necessary framework for African countries and organizations as well as international partners to access and leverage on-going local and international bilateral and multilateral EO-based initiatives across Africa, thereby creating synergies and minimizing*

duplication for the benefit of the continent." In its implementation plan, AfriGEOSS has put forward 6 action areas: i. continental and regional coordination, ii. user needs and applications, iii. data and infrastructure, iv. capacity building, v. resource mobilization, and vi. communication and outreach.

ASREN (GEO PO), the Arab States Research and Education Network, that aims to implement, manage and extend sustainable Pan-Arab e-Infrastructures dedicated for the research and education communities, involves almost 15 countries in the MENA region. NARSS, the National Authority for Remote Sensing & Space Sciences in Egypt, who is leading the Data & Infrastructure Coordination team for AfriGEOSS, is assigned to work closely with ASREN, to exploit e-infrastructure towards fostering EO data dissemination.

Climate Change Impact Observation on Africa's Coastal Zones (GEO-CCIOoACZ) GEO Initiative aims at "*strengthening the continent's existing capacity to collect, analyze, manage, and share up-to-date and high resolution information on climate change impacts in Africa's coastal zones in order to develop mitigation and adaptation measures as well as resilience*." In this context, the Initiative produces and shares up-to-date and high resolution climate change information on African coastal zones, currently as pilot cases that include Egypt. Its objectives are well aligned with GEO-CRADLE's priorities in the NAMEBA region and include the provision of Climate change Information services to end-users at the different levels (i.e. policy and decision makers, stakeholders and local communities).

The **Earth Observations for the Sustainable Development Goals (EO4SDG)** Initiative "*organises and realises the potential of EO and geospatial information to advance the 2030 Agenda and enable societal benefits through achievement of the SDGs*." (see section 3.3.1). Its portfolio includes a number of national pilot projects in GEO Member countries focused on integrating EO with national statistics to better measure, monitor and achieve the SDGs. Relevant activities have already initiated in the Balkan region, where the Inter-Balkan Environmental Center (iBEC, GEO PO), in collaboration with two ministries and two regional authorities organized a high level conference entitled "*1st Round table focusing on the implementation of Sustainable Development Goals in the Balkan Peninsula*" to identify and set up a regional (Balkan) network that will have a key role in the engagement and collaboration with user stakeholders.

Figure 7: 1st Round table focusing on the implementation of Sustainable Development Goals in the Balkan Peninsula, Greece, June 2018.

At the national level, the Greek GEO Office (GGO), in close collaboration with EO4SDG, has been the first active GEO national structure in the NAMEBA region to have reached out to the Hellenic Statistical Authority (ELSTAT), to present the benefits of using EO for SDG reporting and set up a working group to

support the relevant activity, aiming at delivering a best practice example to replicate in the region. In recognition of its efforts, GGO was invited to present its activities in the Scaling Successful Practices panel "*Sharing of Good Practice Country Examples*" of the EO4SDG dedicated session, during the GEO Week/GEO Plenary 2018, in Kyoto, Japan.

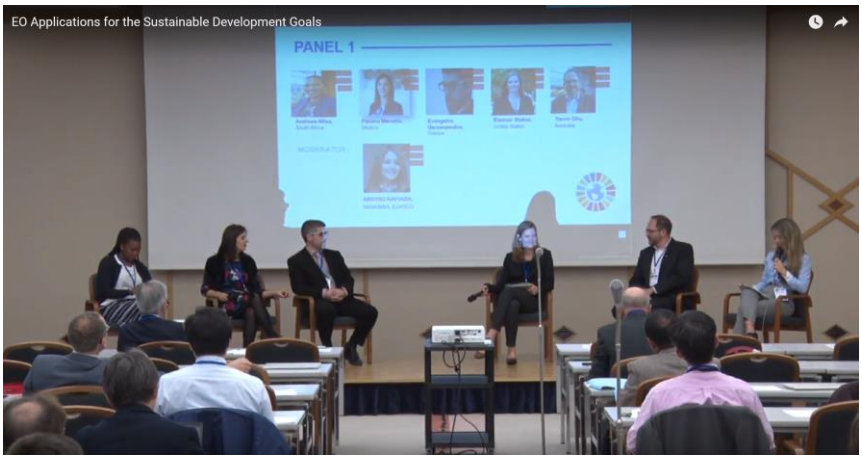


Figure 8: Kyoto GEO Week 2018 Side Event: Earth Observation Applications for the Sustainable Development Goals: GEO Work Programme Efforts and Opportunities for Scaling Successful Methods. Panel presentation of the Greek GEO Office of the national and region efforts towards twinning with NSOs..

3.2.2 Copernicus Uptake

20 years after its "birth" – with the adoption of the Baveno Manifesto – Copernicus and the community built around it have every reason to gaze into the future with confidence. This is driven by the significant milestones achieved in these 20 years, including the establishment of 6 operational core services supplying data and products to respective sectors; the development and operation of a unique constellation of satellites (the Sentinels), which together with contributing missions and world-class in-situ capabilities, offer a wealth of Earth Observation data in support of numerous economic and societal areas; the gradual development of a vibrant and innovative downstream sector which is increasingly bringing the benefits of Earth Observation to the various users. Yet, it isn't only these important achievements that empower the confidence of the European Earth Observation community; it is also the various lessons learned in the process of developing such a complex and ambitious programme. Lessons around the need for effective coordination of multiple stakeholders across borders and disciplines, the necessity of a coherent strategic vision informed by the latest technological and market trends, and the challenges faced when trying to implement sustainable activities that effectively address societal, economic and environmental challenges. Incorporating such lessons learned into the efforts to further build the Copernicus Ecosystem is pivotal.

Alongside the confidence gained by how far Copernicus has made it in these 20 years, one should highlight the excitement felt by the European EO sector with regards to how much further it can get. This is primarily associated with the significant shift which the market for EO data and services is currently undergoing. This is driven by the advent of the Big Data era, spearheaded by Copernicus' free, full and open data policy but also by the emergence of new EO business models relying on large fleets of small satellites (e.g. Planet). This increase in satellites results in a massive increase of EO data; according to Dr Philippe Brunet, Director for Space Policy, Copernicus and Defence at the European Commission, nearly 1 petabyte of data is generated by Copernicus every 3 months. It has also triggered the proliferation of platforms that

facilitate access to EO data and services, whilst also offering advanced cloud computing and processing tools (e.g. machine learning, AI, data cube solutions, etc.) which individual companies or research institutes are not able to afford on their own. This gave rise to a complex tiered landscape (see illustrative figure below – adapted from E. Mondon), whereby numerous public and private actors both within the EO sector but also at the interface with the IT world are working together to provide IaaS, DaaS and PaaS solutions (e.g. DIAS, ESA TEPS, NextGEOSS, SparkInData, GEOSS Platform, EOSC, etc.).

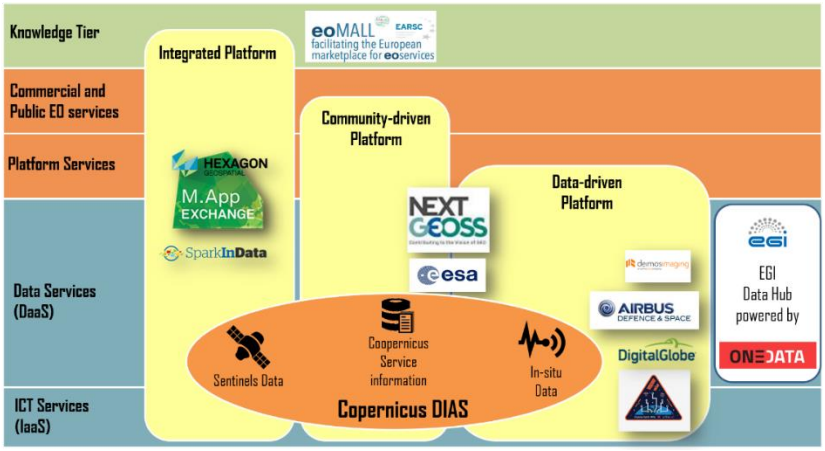


Figure 9: The tiered landscape taking shape at the interjection of the EO and IT sectors

In the wake of these developments, the commercial data market is projected to increase from $1.7 billion in 2015 to $3 billion in 2025**.** This reflects how the "big (Copernicus) data" era presents an enormous opportunity for boosting productivity, innovation and competitiveness of European industry, especially in emerging industries, and in response to key socio-economic and environmental challenges. In light of these developments venture capital (VC) firms are increasingly investing into EO start-ups with some analysts considering that the EO sector has significant potential for exponential growth.

It is within this overall context, that the need to strengthen the European EO capacity and its global footprint becomes more imperative than ever. This recognition has been reaffirmed on several occasions.

> Commissioner Bienkowska has recently underlined that "…*Copernicus can also drive economic growth because it can act as a data source for applications and services"*, echoing President Juncker's conviction that *"Space policy can make an important contribution to the further development of a strong industrial basis in Europe – one of the priorities of my Commission."*

This need has led to a strong current and future commitment to reinforce the European EO capacity through Copernicus and international collaboration on GEO/GEOSS. This is clearly reflected in the Space Strategy for Europe, constitutes a key component of the EuroGEOSS initiative and, pending its approval, will be facilitated by the adoption of the recent EC proposal for an even stronger and more ambitious EU Space programme beyond 2020. Making the most of this increased investment will require sustained efforts towards technological and scientific excellence, but also coordinated support towards "building the Copernicus Ecosystem".

Thus, en route to "Copernicus 2.0", the European Commission is intensifying its efforts towards Copernicus Uptake. The ways this is pursued as well as the cross-section with activities in the NAMEBA region are discussed below.

Towards Copernicus 2.0

With the Sentinels already delivering an unprecedented amount of world-class data and the 6 Copernicus Core services being fully operational, the key stakeholders involved in the governance of Copernicus (i.e. European Commission, European Space Agency, Member States through the Copernicus Committee and the User Forum) are placing strong emphasis on the exploitation of the programme's outputs for the benefit of users across a wide range of economic and societal sectors. In this regard, the Copernicus User Uptake Programme has put emphasis on:

- Helping to raise awareness among actors within and beyond the Copernicus Ecosystem.
- Providing capacity building support towards the realisation of EO-enabled benefits.
- Fostering the development of current and new markets.

To that end, tailored engagement activities delivering appropriate messages to different actors in the Copernicus Ecosystem and helping them make the most out of the information extracted from EO, are required. This includes helping policy makers to understand how EO can provide the necessary evidence for the design and implementation of different policies; working together with users to capture their operational requirements in EO solutions and train them in their integration within their workflows; informing scientists and entrepreneurs on available tools, funding and other support mechanisms; inspiring the young generation to pursue Copernicus-related activities, etc.

The necessity for such a multifaceted approach is even more pronounced in areas where the maturity of EO activities is relatively low, but the "hunger" for greater uptake is notably high – this is exactly the case of the NAMEBA region. But how do Copernicus Uptake activities apply to this specific region? We attempt to answer this question below, looking at each component of the uptake programme individually. More information for some of these elements in provided in the next subsection.

The **central Copernicus User Uptake activities**, include:

- The organisation of **Copernicus Workshops**, focussing on a specific theme (e.g. Fisheries and Aquaculture, Raw Materials, etc.) or addressing the needs of a larger stakeholder community (e.g. Industry, the Ecosystem as a whole, etc.). Such workshops have seen a strong participation by entities from the NAMEBA region, predominantly from EU Member States.

> **Industry Workshop:** In April 2017, GEO-CRADLE and EARSC worked in close cooperation with DG GROW and DG RTD of the European Commission to organise a special workshop on *"Improving EO Services Industry involvement in EU Space Programmes and Initiatives"*. This brought together actors across the value chain and raised awareness on opportunities in the NAMEBA region. Several collaborations were triggered by this workshop for upcoming calls and tenders.

- The execution of **Copernicus Training and Information Sessions** across and beyond the EU Member States, aimed at creating increased traction with the local/regional communities. Such sessions have taken place in Greece (Athens-2016), Cyprus (Paphos-2018) and Bulgaria (Sofia-2018), offering a unique opportunity for the local sectors to network, understand different aspects of Copernicus and get hands-on training.
- The establishment of the **Copernicus Academy and Copernicus Relays** networks, which promote a wide range of activities at national and cross-border level and shall be coordinated through two recently started H2020-funded projects (CopHub.AC and CoRdiNet). Today, there are over 200 members in 42 countries across 4 continents, with many have been established in Cyprus, Greece, Romania, Bulgaria, Croatia, Malta, Slovenia, etc. Yet, it isn't only European countries that

represent NAMEBA; based in Tunisia the Sahara and Sahel Observatory is an active member, with more interest having been solicited for other MENA countries through GEO-CRADLE.

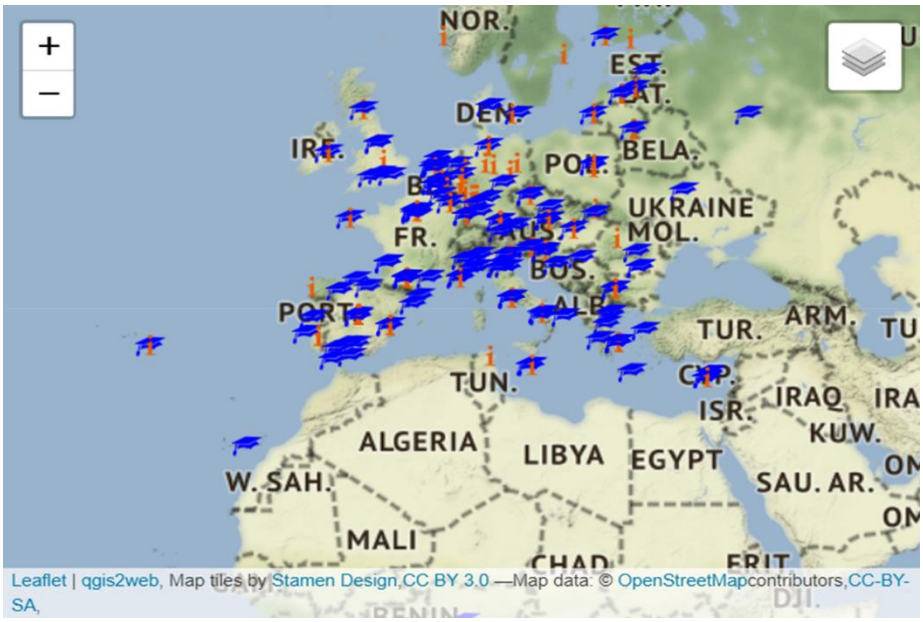


Figure 10: Map of the Copernicus Academies and Relays Network[7]

- The production and dissemination of multiple **factsheets and other informational or promotional material**, through the central Copernicus.eu website but also via social media and during events.

The **service-specific User Uptake Programmes**, have been focussing on:

- The demonstration of the use of Copernicus Core Services in specific applications (e.g. CMEMS and CAMS). In that regard, CAMS has launched a dedicated call targeting South and Eastern Europe. In this context, DiscovAIR, one of the success stories focusses on Greece and Cyprus (see figure below).
- Raising awareness amongst potential new users through dedicated campaigns (e.g. SEA).

[7] Map accessed on the 19th of November on copernicus.eu.

Figure 11: DiscovAIR has been recognised as a success story, bringing the benefits of CAMS to tourists and citizens in South Europe

The Caroline Herschel **Framework Partnership Agreement (FPA) on Copernicus** which allows Member States to pursue different activities at national level including:

- Local awareness events, training sessions, online courses, hackathons, etc (tier 1).
- Global or cross-border actions, incl. internationalisation of companies (tier 2).
- Actions supporting innovation businesses and start-ups, their incubation and maturity, etc. (tier 3).

In this context, Greece, Romania, Cyprus and Bulgaria have all set up their annual programmes and will start implementing FPA activities.

The **Blueprint for Sectorial cooperation on skills** – serving as the main tool to deliver sector-specific skills solutions under the New Skills Agenda for Europe. In this regard, the Blueprint connected to geo-information, is being realised through EO4GEO, a project looking into skills development and capacity building in the space geo-information sector in support of Copernicus User Uptake. This will be also supported by the recently issued COSME tender on "Copernicus digital skills initiatives support action". The EO4GEO consortium includes ROSA as the key EO player in Romania and has been organising activities in Balkan countries (see for example the recent EO4GEO workshop in Patras, Greece). Yet, its reach to the greater NAMEBA region is so far limited.

The **Research Users Support service** (RUS) activity, managed by ESA and providing training of the trainers, as well as digital and space data manipulation skills development. A number of activities have or are targeting actors in the NAMEBA region. This includes the upcoming sessions in Sofia (BG) and Alexandria (EG).

Other **ESA-led activities** such as the EO4SD programme aimed at greater uptake of EO solutions in the context of sustainable development (in cooperation with International Financial Institutions); and the Sentinel Economic Benefits Study which helps to raise awareness on the concrete benefits felt by users through the promotion of operational cases. In the former case, more information can be found under section 3.3.4. SEBS has assembled and will analyse a number of cases from the Balkan region and potentially some in MENA too.

The **Copernicus building skills actions,** aimed at stimulating the growth of the geospatial-related jobs in Europe and the uptake of Copernicus data, through a series of KIC-driven activities.

The recently launched EuroGEOSS Initiative which follows a user-centric approach to enable the sustainable exploitation of EO assets in Europe and the wider user uptake of EO-based solutions. Several partners from the NAMEBA region have been involved in the EuroGEOSS Action Groups with Greece holding the record for participation across the whole of Europe. Moreover, multiple organisation from NAMEBA are involved in the EuroGEOSS project that shall kick off in 2019.

Other **national activities** (e.g. Space for smarter government programme in the UK, or different programmes in the Netherlands) promoting the uptake of EO in sectors/policies of national importance. Some of these activities have a direct interface with the region of interest. For instance, G4AW projects have been taking place in Africa – albeit not the Northern part.

The upcoming **DIAS-related user uptake activities** organised by the different DIAS teams and aimed at building an ecosystem around their offering.

Liaison activities undertaken by different actors (e.g. EC DG GROW, DG RTD, ESA, EARSC, etc.) and aimed at promoting the uptake of Copernicus either in support of major international policy frameworks (e.g. the 2030 Sustainable Development Agenda, the Paris Agreement and the Sendai Framework) or in vertical markets (through the engagement of user communities at large, represented by entities such as COPA-

COGECA, IRENA, etc.). In this regard, a solid channel has been established between EARSC and AARSE, yielding tangible results for the region.

As can be readily identified, these activities are targeted at different stakeholder groups and are coordinated/led by different actors. In that regard, a visualisation (non-exhaustive) of the Copernicus Ecosystem Support Landscape is provided below. (credit: Evenflow)

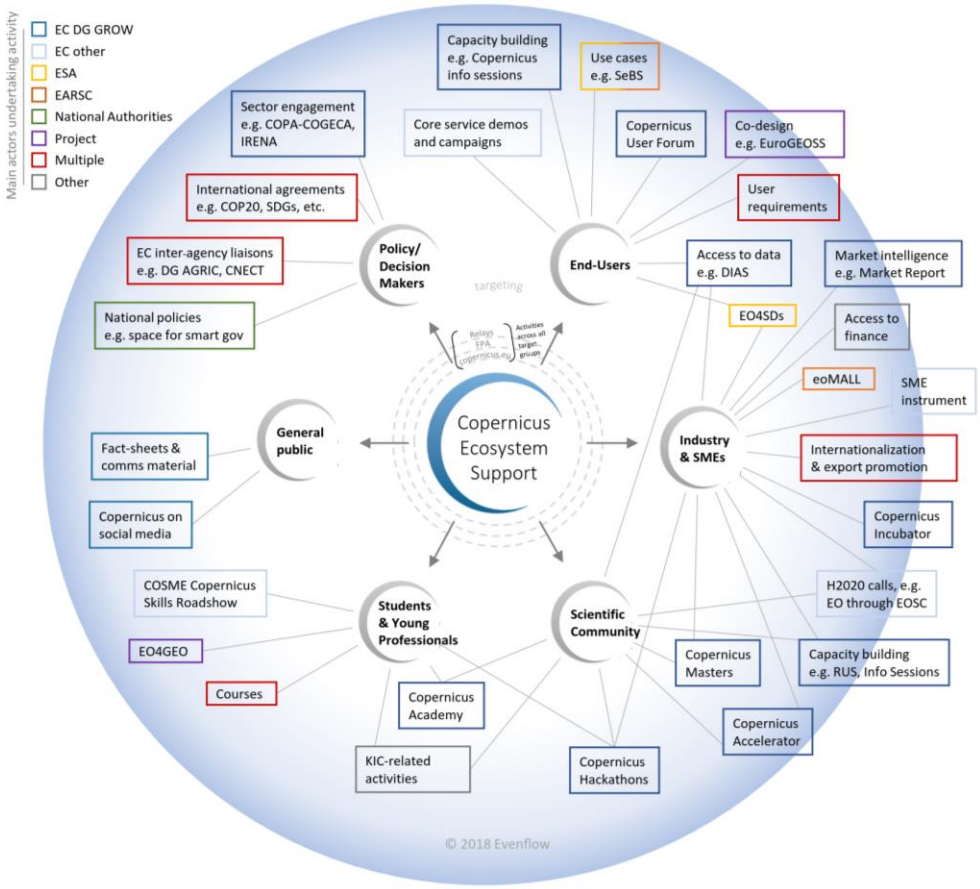


Figure 12: The Copernicus Ecosystem support landscape

Maximising the impact of these activities on the EO sectors of NAMEBA countries and effectively realising the significant socio-economic and environmental benefits associated with the uptake of EO data and services is directly tied to effectively addressing a range of challenges and barriers. Some of the regional challenges are discussed in 3.4.

GMES & Africa is promoting long-term cooperation in space science and technology between the EU and countries and Africa. Specifically, it seeks to maintain, improve and sustain access to Copernicus data and to enable its use by African states towards addressing global challenges and generating sustainable development.

The action brings together European and African partners to develop and deliver services to support informed decision-making in strategic thematic areas; in the 1st phase this focuses on: (i) long-term management of natural resources and water resources management; and (ii) monitoring and forecasting of oceanography variables, coastal area monitoring, ship traffic and pollution monitoring, and marine weather forecast. This work will be implemented through Regional Implementation Centres (RICs). Moreover, capacity building (institutional, human and technical) is carried out by the Pan African University and others.

The result is promoting greater operational use of Copernicus and other EO data to promote sustainable development by decision-makers, institutions and businesses. In that regard, it will be a key vehicle for the increased uptake of EO in the North African region, which – through GEO-CRADLE – is well linked to counterparts in the Balkan and Middle East regions.

3.3 The footprint of other flagship initiatives

Aside from and complementary to the two key programmes that are at the epicentre of this roadmap, several other flagship initiatives operate in the region. These are discussed below.

3.3.1 UN Sustainable Development Agenda 2030

The 2030 Agenda for Sustainable Development, which was adopted by world leaders in 2015 at the UN Summit, including the following 17 Sustainable Development Goals (SDGs), officially came into force on 1/1/2016.

Figure 13: The Sustainable Development Goals

The SDGs build on the success of the Millennium Development Goals (MDGs) and aim to go further to end all forms of poverty. The new Goals are unique in that they call for action over the next 15 years by all countries, poor, rich and middle-income to promote prosperity while protecting the planet. They recognize that ending poverty must go hand-in-hand with strategies that build economic growth and addresses a range of social needs including education, health, social protection, and job opportunities, while tackling climate change and environmental protection.

The SDGs Report 2018 found that conflict and climate change were major contributing factors leading to growing numbers of people facing hunger and forced displacement, as well as curtailing progress towards universal access to basic water and sanitation services.

More specifically, for the first time in more than a decade, there are now approximately 38 million more hungry people in the world, rising from 777 million in 2015 to 815 million in 2016. According to the report, conflict is now one of the main drivers of food insecurity in 18 countries. In 2017, the world experienced the costliest North Atlantic hurricane season on record, driving the global economic losses attributed to the disasters to over $300 billion. In 2015, 2.3 billion people still lacked even a basic level of sanitation service.

Other findings of the Report include:

- Nine out of 10 people living in cities breathe polluted air.
- Land degradation threatens the livelihoods of over one billion people.
- In the least developed countries, the proportion of population with access to electricity has more than doubled between 2000 and 2016. In 2016, the absolute number of people living without electricity dropped below the symbolic threshold of one billion.
- The under-five mortality rate dropped by almost 50 per cent.

As the global community moves forward to achieve the SDGs and address existing challenges, reliable, timely, accessible and disaggregated data is critically needed. This requires technology and innovation, increased resources and political commitment to build strong data and statistical systems in all countries.

Many countries have set up their own strategies guiding the implementation of SDG-related activities. This is best reflected in the voluntary national reviews, whose aim is to facilitate the sharing of experiences, including successes, challenges and lessons learned, with a view to accelerating the implementation of the 2030 Agenda. The VNRs also seek to strengthen policies and institutions of governments and to mobilize multi-stakeholder support and partnerships for the implementation of the SDGs. In this regard, many NAMEBA countries have submitted VNRs and developed their corresponding national strategies: Egypt, Turkey and Morocco in 2016; Cyprus in 2017; Albania, Greece, Romania, Lebanon, Egypt (renewed), Saudi Arabia and UAE in 2018; and many more are expected in 2019 and 2020 (e.g. Israel, Serbia, Algeria, Kuwait, Oman, Tunisia).

SDG Implementation in NAMEBA: The example of Egypt

Egypt has shown a **strong and clear resolve to fulfil the sustainable development strategy**. Following the launch of "Egypt's Vision 2030" in March 2015, which articulates Egypt's National Strategy for Sustainable Development (SDS), Egypt was one of the first countries globally to provide a voluntary national review at the first High Level Political Forum (HLPF) in 2016. Thus, in line with its constitutional mandate, the Government of Egypt embarked on launching major national projects that serve the objectives of inclusive and sustainable development. Their implementation is pursued through concerted, multi-stakeholder collaboration including several ministries and governmental agencies, the private sector, civil society organizations (CSOs), and international development partners.
Egypt aspires to act as a pioneer for the implementation of SDGs and as a multiplier for Africa, the Mediterranean and the Arab World. This is exemplified, *inter alia*, by its strong contribution to the African Union Commission (AUC) efforts towards the adoption of SDGs within Agenda 2063; the organisation of the 2nd Africa Regional Forum on Sustainable Development; and a number of capacity building efforts in developing countries promoted by the Egyptian Agency for Partnership for Development (EAPD). Moreover, Egypt is on a path to be a trendsetter for new forms of financing for the implementation of the SDGs in the region. In that regard, the Ministry of Investment and International Cooperation (MoIIC) in cooperation with the World Bank and UNDP is spearheading impact investment – an effective way to involve industry in the implementation process of the SDGs.

3.3.2 UN Framework Convention on Climate Change, Kyoto Protocol, and Paris Agreement

In 1992, countries joined an international treaty, the United Nations Framework Convention on Climate Change, as a framework for international cooperation to combat climate change by limiting average global temperature increases and the resulting climate change, and coping with impacts that were, by then, inevitable. Currently, there are 197 Parties to the Convention.

By 1995, countries launched negotiations to strengthen the global response to climate change, and, two years later, adopted the Kyoto Protocol. The Kyoto Protocol legally binds developed country Parties to emission reduction targets. The Protocol's first commitment period started in 2008 and ended in 2012. The second commitment period began on 1/1/2013 and will end in 2020. There are now 192 Parties to the Kyoto Protocol.

In 2015 the Paris Agreement was adopted marking the latest step in the evolution of the UN climate change regime and building on the work undertaken under the Convention. The Paris Agreement charts a new course in the global effort to combat climate change, seeking to accelerate and intensify the actions and investment needed for a sustainable low carbon future. Its central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. The Agreement also aims to strengthen the ability of countries to deal with the impacts of climate change.

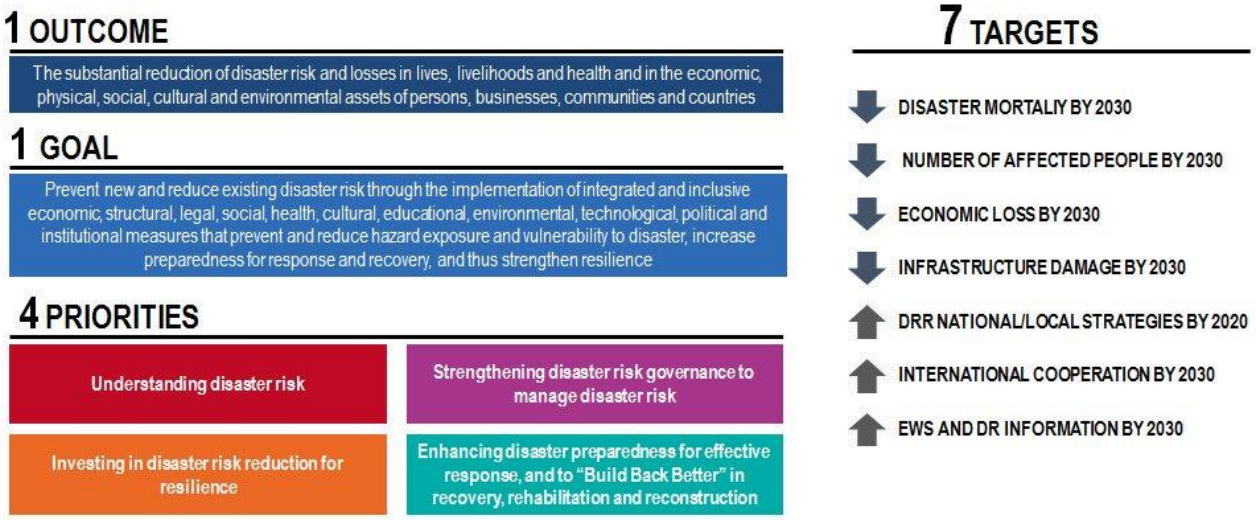
To reach these ambitious goals, appropriate financial flows, including by, before 2025, setting a new goal on the provision of finance from the USD 100 billion floor, and an enhanced capacity building framework, including an Initiative for Capacity Building, will be put in place: thus, supporting action by developing countries and the most vulnerable countries, in line with their own national objectives. The Agreement will also enhance transparency of action and support through a more robust transparency framework.

Air pollution is one of the challenging environmental problems in the whole NAMEBA region, contributing to human health problems, agricultural crop loss and climate change at the regional scale. Systematic **biomass burning**, either from forest or agricultural fires, and lately for residential heating, contributes significantly to aerosol levels over the EM, especially under the prevalence of strong north-eastern winds in the summertime period (Etesians), due to long-range transport or recirculation of local emissions. Another significant aerosol fraction is **African dust**, which is found to consist 16% of the annually averaged aerosol optical depth. Lastly, the influence from **large urban centres** (e.g. Athens, Istanbul, Cairo) on the regional background pollution levels is permanent and substantial. In this line, continuous monitoring of atmospheric composition is imperative to identify sources, levels and processes in order to devise measures for mitigation, also under the prism of the ongoing climate change.

3.3.3 UN Sendai Framework for Disaster Risk Reduction

The UN Sendai Framework for Disaster Risk Reduction 2015-2030 is the first major agreement of the post-2015 development agenda, with seven targets and four priorities for action.

It was adopted in 2015 as a 15-year, voluntary, non-binding agreement which recognizes that the State has the primary role to reduce disaster risk but that responsibility should be shared with other stakeholders including local government, the private sector and other stakeholders.



The Sendai Framework is the successor instrument to the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters, and charts the global course over the next 15 years. During the consultations and negotiations that led to its finalization, strong calls were made to develop practical guidance to support implementation, ensure engagement and ownership of action by all stakeholders, and strengthen accountability in disaster risk reduction.

Paragraph 48 (c) of the Sendai Framework calls upon "the United Nations Office for Disaster Risk Reduction (UNISDR), in particular, to support the implementation, follow-up and review of this framework through […] generating evidence-based and practical guidance for implementation in close collaboration with States, and through mobilization of experts; reinforcing a culture of prevention in relevant stakeholders […]". In order to support the process, a number of targeted Sendai Framework implementation guides shall be developed.

3.3.4 EO4SD

Starting in 2016, ESA has launched a series of activities in support of sustainable development. In this context, the overall objective of the EO4SD programme, is to integrate EO-based products and services as best-practice environmental information in the planning and implementation of the development projects, programmes and activities of the International Financing Institutions (IFIs – such as World Bank, International Fund for Agricultural Development, etc.), together with their respective Client States. So far 7 thematic domains have been targeted including Agriculture and Rural Development, Urban Development, Water Resources Management, Climate Resilience, Disaster Risk Reduction, Marine Resources, Conflict-Fragility and Resilience. It is worth noting that several of these activities are either targeting countries in NAMEBA (e.g. the "Green Morocco Plan") or are carried out by key partners in the region (e.g. NOA in the Climate Resilience Action). An additional project has been launched for the Eastern European Region, with the focus including Moldova.

3.3.5 Prima Initiative

The Partnership for Research and Innovation in the Mediterranean Area (PRIMA) is a joint programme focused on the development and application of solutions for food systems and water resources in the Mediterranean basin.

The main objective of this ten-year initiative (2018-2028), which is partly funded by EU's research and innovation programme Horizon 2020, is to devise new R&I approaches to improve water availability and sustainable agriculture production in a region heavily distressed by climate change, urbanisation and population growth.

More specifically PRIMA focuses on three thematic areas:

1. **Management of water**: Integrated and sustainable management of water for arid and semi-arid Mediterranean areas.
2. **Farming systems**: Sustainable farming systems under Mediterranean environmental constraints.
3. **Agro-Food value chain**: Sustainable Mediterranean agro-food value chain for regional and local development.

PRIMA consists of European Union Member States, Horizon 2020 Associated Countries and Mediterranean Partner Countries on an equal footing basis (co-ownership, co-management and co-funding) with the Participation of the European Commission, under the framework of an art.185 TFEU. The partnership currently consists of 19 participating countries: Algeria, Croatia, Cyprus, Egypt, France, Germany, Greece, Israel, Italy, Jordan, Lebanon, Luxembourg, Malta, Morocco, Portugal, Slovenia, Spain, Tunisia and Turkey.

It will be financed through a combination of funding from participating countries (currently €274 million), and a €220 million contribution from the EU through Horizon 2020 (2014-2020).

The PRIMA Foundation launched its first calls for proposals in February 2018 to mobilize the Euro-Mediterranean scientific communities, stakeholders and public and private entities to identify R&I solutions for a more sustainable water and food management:

CALL	THEMATIC AREA	TOPIC	TYPE OF ACTION	BUDGET
Section 2 – Multi-topic 2018	Agro-Food value chain, Farming systems, Management of water	Transnational call funded by Participating States	Research and Innovation Action (RIA)	EUR 30 million
Section 1 – Agro-food Value Chain 2018	Agro-Food value chain	Implementing innovation in Mediterranean Agro-food chains by smallholders and SMEs	Innovation action (IA)	EUR 6.1 million
Section 1 – Farming Systems 2018	Farming systems	Improving the sustainability of Mediterranean agro-ecosystems	RIA Research and Innovation action	EUR 6.1 million
Section 1 – Management of Water 2018	Management of water	Water reuse and water desalination for agricultural and food production	Research and Innovation Action (RIA)	EUR 6.1 million

By funding R&I through competitive calls, PRIMA aims to "*build research and innovation capacities and to develop knowledge and common innovative solutions for agro-food systems, to make them sustainable, and for integrated water provision and management in the Mediterranean area, to make those systems and that provision and management more climate resilient, efficient, cost-effective and environmentally and socially sustainable, and to contribute to solving water scarcity, food security, nutrition, health, well-being and migration problems upstream*".

PRIMA also aims to contribute to United Nations' Agenda 2030 through the achievement of the Sustainable Development Goals (SDGs). As can be easily understood, several actors from the NAMEBA region are heavily involved in the recently launched actions.

3.3.6 Belmont Forum

Located around the world, Belmont Forum members and partner organizations work together to direct and fund research on environmental change. More specifically, this forum, which is comprised of 26 funding agencies on six continents, accelerates the delivery of the environmental research needed to remove critical barriers to sustainability by aligning and mobilizing international resources, by adding value to existing national investments and by encouraging interdisciplinary and trans-disciplinary partnerships.

The Belmont Forum Members are legally allowed to mobilize resources from national or international research funds and are engaged in activities that address the Belmont Challenge: a global, environmental research mission for sustainability. They are the following: MINCyT from Argentina; CSIRO from Australia; BMBWF from Austria; FAPESP from Brazil; NSFC from China; MOST from Chinese Taipei; European Commission (EC); AllEnvi and ANR from France; DFG and BMBF from Germany; MoES from India; CNR from Italy; PASRES from Ivory Coast; MEXT and JST from Japan; CONACYT from Mexico; NOW from The Netherlands; RCN from Norway; QNRF from Qatar; NRF from South Africa; Formas and VR from Sweden; TÜBİTAK from Turkey; NERC from United Kingdom; and NSF from United States of America.

The Belmont Forum Partners are organizations that subscribe to the Belmont Challenge, but do not fund research and/or do not meet the criteria for membership. They are the following: Group on Earth Observations (GEO); The InterAcademy Partnership (IAP); International Council for Science (ICSU); International Institute for Applied Systems Analysis (IIASA); International Social Science Council (ISSC); SysTem for Analysis, Research & Training (START); United States Global Change Research Program (USGCRP); The S & T Alliance for Global Sustainability.

The transnational research initiatives that are being promoted by the Belmont Forum are developed in synergy with Horizon 2020 and with Innovation projects developed by EU Members States. The Research and Innovation Directorate General's involvement in the Belmont Forum witnesses the European Commission's conviction that addressing the ever further increasing needs resulting from the global change challenges has to be supported by an open, transdisciplinary and results-oriented international scientific cooperation. It strengthens the already major financial involvement of the European Union in international initiatives such as the Global Earth Observation System of Systems, the Global Alliance for Chronic Diseases, the EU-Africa Research and Innovation Partnership on Food and Nutrition Security and Sustainable Agriculture and the Future Earth initiative. It thus further consolidates the place of the EU-funded research at the very heart of the current world-wide move towards a more active involvement of Science, Technology and Innovation in the realisation of the UN Sustainable Development Goals.

As one of its major activities, the Belmont Forum launches Collaborative Research Actions (CRAs) on specific themes (48 different projects funded so far). The CRAs have centralized objectives but the financing of the individual components/projects is the responsibility of the various participating agencies. EU funded programs such as ERA-NETs, and EU Joint Programming Initiatives are directly involved in the ongoing implementation of CRAs in the following fields: Coastal Vulnerability (2012), Freshwater Security (2012), Food Security and Land Use Change (2013), E-Infrastructures and Data Management (2013), Scenarios of Biodiversity and Ecosystem Services (2014), Arctic Observing and Research for Sustainability (2014), Mountains as Sentinels of Change (2015), Climate Predictability and Inter-Regional Linkages (2015), Sustainable Urbanisation Global Initiative / Food-Water-Energy Nexus; Transformations 2 Sustainability (2016); and Scenarios of Biodiversity and Ecosystem Services II (2017), and Science-driven e-Infrastructure Innovation for the Enhancement of Transnational, Interdisciplinary and Transdisciplinary Data Use in Environmental Change (2018).

Last but not least, the Belmont Forum is implementing a global open data policy and principles with input from scientific and stakeholder communities. Open data access is being developed through activity in four thematic areas: Coordination; Data Planning; e-Infrastructures; and Human Dimensions.

3.3.7 Other national and cross-border initiatives

Space technologies, infrastructure, services and data availability steer the growth of EO operators capable of providing customised and specialised high added-value services to a growing landscape of users in order to address societal challenges and big global concerns. In this context, the development of the EO sector in the NAMEBA region has been the subject (not necessarily directly) of several research and innovation actions at various levels the last decade:

- Actions under the European Regional Development Fund (Cross-Border and Transnational Cooperation Programmes);
- Actions promoted by national funds and co-funded by the European Commission (e.g. EEA and Norway Grants);
- Interregional cooperation actions with partners beyond the EU (e.g. Instrument for Pre-accession Assistance, European Neighbourhood Instrument);
- Actions funded by other European bodies (e.g. Life Programme);
- Actions funded by other entities (e.g. World Bank Future Earth Initiative, national).

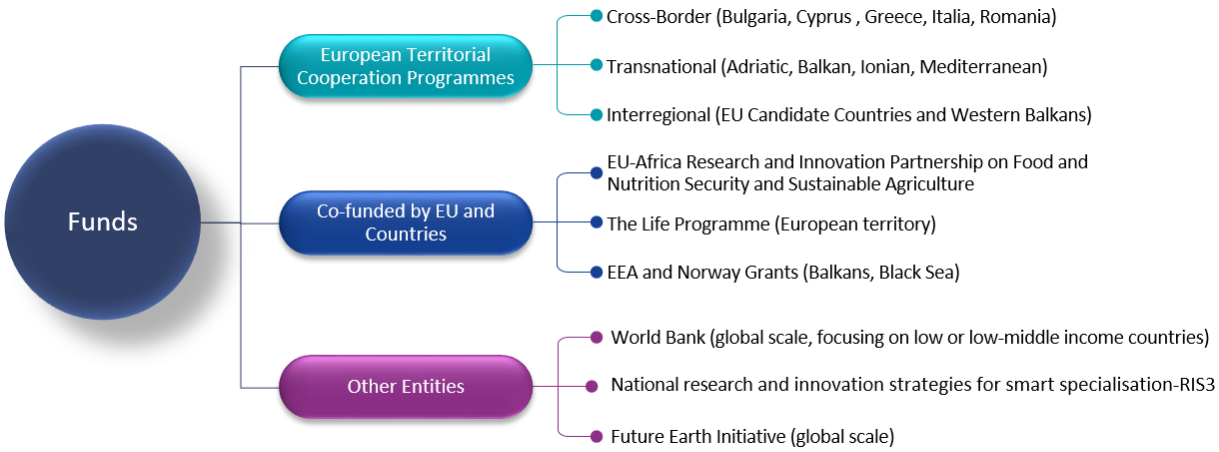


Figure 14: Scheme of the funding programmes

European Territorial Cooperation Programmes

European Territorial Cooperation, also referred to as Interreg, supports **cross-border cooperation**, **transnational cooperation** and **interregional** (external border) **cooperation**. It is financed by the European Regional Development Fund (ERDF) with a total envelope of EUR 10.1 billion (around 20% allocated in the participant countries of GEO-CRADLE). The budget also includes ERDF allocation for Member States to participate in EU external border cooperation programmes supported by Instrument for Pre-Accession Assistance and European Neighbourhood Instrument.

Cross-border and transnational cooperation programmes are an important mechanism for the participant countries to work together on important issues, enabling the beneficiaries to share expertise and resources and bring direct benefits to all members of the participant countries and the region as a whole. Numerous cross-border and transnational programmes are ongoing at any time across a geographically wide region, as illustrated below.

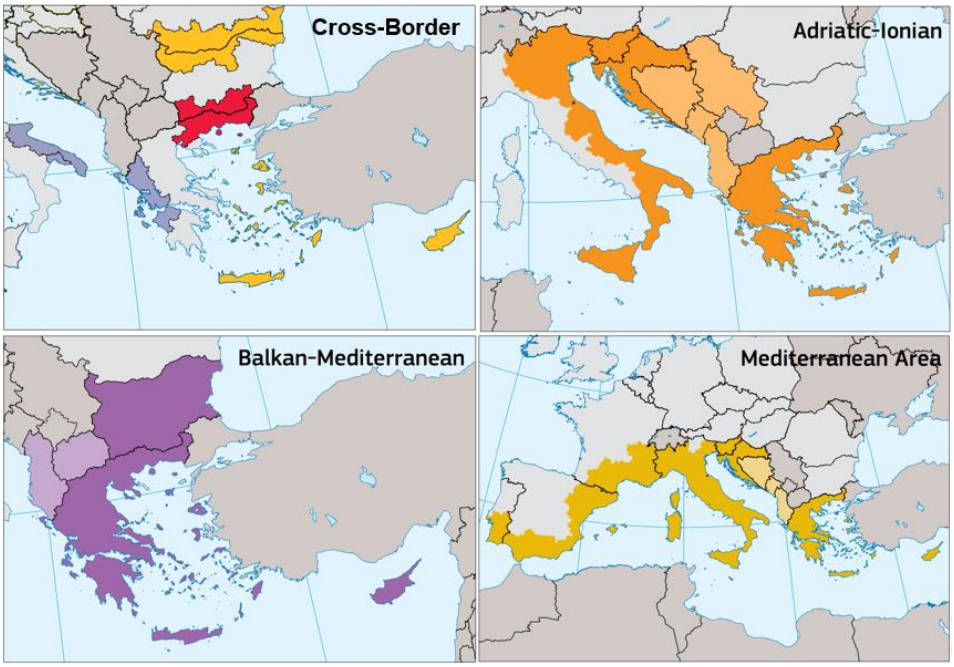


Figure 15: The area of the cross-border programmes co-financed by the ERDF are illustrated in the upper left map, each program is shown with a specific colour. The rest of the maps indicate the transnational cooperation programs. It should be mentioned that only cross-border and transnational programmes within the GEO-CRADLE region of interest are presented (source: DG-REGIO)

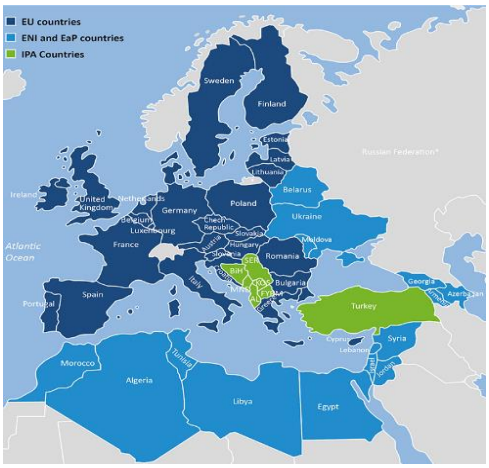


Figure 16: The eligible area of the ENI and IPA interregional programmes, over the period 2014-2020

The cross-border and transnational programmes of 2014-2020 cover a large area of interest however does not include the North African and Middle East countries. Since 2007, the EU is developing an increasingly close relationship with its neighbouring countries implementing numerous technical assistance programs to align the policies, institutional structures and financing mechanisms of third countries with those of the EU. Specifically, through the Instrument for Pre-Accession Assistance (IPA) and the European Neighbourhood Instrument (ENI), the EU strives to reduce regional disparities within and between countries by providing support for effective and efficient funding of structurally weak regions, including territorial cooperation between border regions. The total amount agreed for the IPA and ENI package is around €12 and €15 million, respectively, over the period 2014-2020. Both IPA and ENI include the promotion and implementation of concrete regional applications/services falling under the scope of regional development (transport, environment, regional and economic development); human resources (strengthening human capital and combating exclusion); and rural development

The current programming period *2014 - 2020* of European Territorial Cooperation (including the interregional IPA and ENI programmes) places a renewed emphasis on gearing towards the Europe 2020 Strategy categorizing Interreg's thematic objectives along the lines of the three broad thematic areas of **smart**, **sustainable** and **inclusive growth**. These areas are closely related to GEO-CRADLE's thematic areas however each is characterized by its own thematic objectives as summarized in the Table 1.

Table 1: The thematic objectives supporting growth for the period 2014-2020 and their connection with the 4 GEO-CRADLE related thematic areas (the underlined Interreg thematic objectives indicated direct relation with GEO-CRADLE).

		Interreg thematic objectives	GEO-CRADLE related thematic area
Europe 2020 Goals	Smart growth	▪ Strengthening research, technological development and innovation; ▪ Enhancing access to, and use and quality of, ICT; ▪ Enhancing the competitiveness of SMEs, of the agricultural sector and of the fishery and aquaculture sector	▪ Improved Food Security ▪ Water Extreme Management ▪ Access to Raw Materials
	Sustainable growth	▪ Supporting the shift towards a low-carbon economy; ▪ Promoting climate change adaptation, risk prevention and management; ▪ Preserving and protecting the environment and promoting resource efficiency; ▪ Promoting sustainable transport and removing bottlenecks in key network infrastructures;	▪ Adaptation to Climate Change ▪ Access to Energy ▪ Improved Food Security
	Inclusive growth	▪ Promoting sustainable and quality employment and supporting labour mobility; ▪ Promoting social inclusion, combating poverty and any discrimination; ▪ Investing in education, training and vocational training for skills and lifelong learning; ▪ Enhancing institutional capacity of public authorities and stakeholders and efficient public administration	NA -

Co-founded by EU and countries

The European Economic Area (EEA) and Norway Grants

The EEA and Norway Grants are the financial contributions from Iceland, Liechtenstein and Norway to European solidarity and cohesion. In the programming period 2014-2021, EUR 2.8 billion has been made available for projects, reinforcing EU investments in central and southern Europe, across the following thematic areas:

- Innovation, research, education and competitiveness
- Social inclusion, youth employment and poverty reduction
- Environment, energy, climate change and low-carbon economy
- Culture, civil society, good governance and fundamental rights
- Justice and home affairs

The Fund supports projects addressing common European challenges through regional cross-border and transnational cooperation in the form of knowledge sharing, exchange of good practice and capacity building across the priority sectors of the EEA and Norway Grants 2014-2021, totally linked to the vision of GEOCRADLE (underlined objectives), sharing knowledge and capacity building of EO applications.

The LIFE Programme

Running over 25 years, the LIFE Programme is one of the cornerstones of EU environmental and climate funding. Till now, LIFE has played a significant role in the implementation of major EU environmental and climate legislations. Applicants and beneficiaries supported to develop and grow the prospects of services (including EO related services) being used in business and organizations for their operations under the sub-programmes of **Environment** (Priority Areas i) Environment and Resource Efficiency; ii) Nature and Biodiversity; and iii) Environmental Governance and Information) and **Climate** (Priority Areas: i) Climate Change Mitigation; ii) Climate Change Adaptation; and iii) Climate Governance and Information).

Building upon the results of the mid-term evaluation of the 2014-2020 programme and an impact assessment the need for a new strengthened LIFE programme is highlighted in order to implement the Paris agreement and support the fight against climate change. In this context, for the next long-term EU budget 2021-2027, the Commission is proposing to increase funding by almost 60% for LIFE (intension to allocate € 5.45 billion).

EU-Africa FNSAA

Both sides of Africa-EU Strategy agreed and published a joint Research and Innovation Partnership recommending actions to better align Africa's scientific and technological activities with EU's policy and research priorities in the domain of Food and Nutrition Security and Sustainable Agriculture (FNSAA). A number of these recommendations has led to the targeted calls under EU funding bodies (H2020), in which joint research at local level are implemented focussing on strengthening capacity-building (human, research infrastructures/institutional) and improving income growth and rural development, contributing as such to SDGs.

Other Entities

World Bank

Recent global developments favour bold climate action by the World Bank Group (WBG). In this context, the WBG aims to deepen and scale up its action in six high-impact areas i) Renewable Energy and Energy Efficiency, ii) Sustainable Mobility, iii) Sustainable and Resilient Cities, iv) Climate-Smart Land Use, Water, and Food Security, v) Green Competitiveness, and vi) Leaving No One Behind, (underlined are the areas that have direct or indirect connection with GEOCRADLE's thematic areas). The Climate Change Action Plan reconfirms the WBG's commitment to increase the climate-related share of its portfolio from 21 to 28 percent by 2020 in response to client demand, with total financing of potentially $29 billion per year by 2020. Through the Global Partnership for Sustainable Development Data (GPSDD), World Bank Group (WBG) encourages collaborations for Earth Observation data production, dissemination and use in low-income countries and lower-middle-income countries. In this context, a diverse series of projects have been implemented which benefit local decision-making, fostering synergies between the communities of non-official data and official statistics and promoting methodologies directed towards sustainable development generally, and linked to the SDGs. This can be highlighted by the two previous rounds of funding warder in 2017 and in 2018 (22 different projects funded so far around the world.

Future Earth Initiative

The Future Earth initiative was launched at the Rio+20 Summit following the promotion by the Science and Technology Alliance for Global Sustainability (in short the 'Alliance', composed of the International

council for Science, the international Social Sciences Council, the Belmont Forum, UNEP, UNESCO, the United Nations University and the World Meteorological Organisation). Future Earth forms a global, independent platform for scientific collaboration on global change research and sustainability around 8 key sustainability challenges identified in the Future Earth Vision 2025, namely: 'Healthy and resilient cities'; 'Safeguarding natural assets'; 'Decarbonising energy systems'; 'Water, energy, food nexus'; 'resilience, threshold and transformation'; 'Sustainable production'; 'Human and planetary health'; 'Rural futures'.

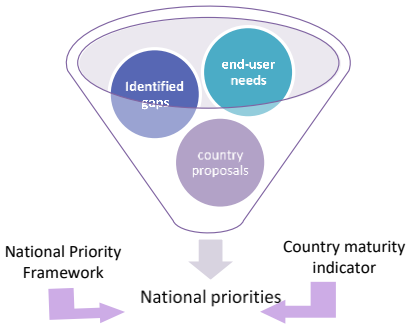
National

The value of EO in a changing world is recognised more and more by several national entities. With a focus on delivery and impact, regions and countries will explore the use and applications of EO in both the public and private sectors for the benefit of society, via a series of funding programs such as the regional Research and Innovation Strategies for Smart Specialization.

Initiative	Scale	GEO-CRADLE related thematic area
Interreg - Cross Border and Transnational Territorial Cooperation Programmes	Adriatic, Ionian Balkan and Mediterranean Territories	▪ Improved Food Security ▪ Water Extreme Management ▪ Access to Raw Materials ▪ Adaptation to Climate Change ▪ Access to Energy
European Neighbourhood Policy	28 EU member states, Algeria, Armenia, Azerbaijan, Belarus, Egypt, Georgia, Israel, Jordan, Lebanon, Libya, Moldova, Morocco, Palestine, Syria, Tunisia, Ukraine	▪ Improved Food Security ▪ Water Extreme Management ▪ Access to Raw Materials ▪ Adaptation to Climate Change ▪ Access to Energy
Instrument for Pre-Assession Assistance	EU candidate countries (Turkey, Albania, Montenegro, Serbia and the former Yugoslav Republic of Macedonia) are eligible for all five components of IPA; and Potential candidate countries in the Western Balkans (Bosnia-Herzegovina, Kosovo under UN Security Council Resolution 1244/99)	▪ Improved Food Security ▪ Water Extreme Management ▪ Access to Raw Materials ▪ Adaptation to Climate Change ▪ Access to Energy
The European Economic Area (EEA) and Norway Grants	Bulgaria, Croatia, Cyprus, Czech Republic , Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, Romania , Slovakia and Slovenia and Eligible countries are the 15 Beneficiary States, and the selected non-EEA countries Albania, Belarus, Bosnia and Herzegovina, Former Yugoslav Republic of Macedonia, Moldova, Montenegro, Russia, Serbia, Turkey and Ukraine	▪ Water Extreme Management ▪ Access to Raw Materials ▪ Adaptation to Climate Change ▪ Access to Energy
The Life Programme	28 EU member states	▪ Improved Food Security ▪ Water Extreme Management ▪ Adaptation to Climate Change ▪ Access to Energy
World Bank and Global Partnership for Sustainable Development Data	Worldwide with emphasis on low- and middle-income countries	▪ Improved Food Security ▪ Water Extreme Management ▪ Adaptation to Climate Change ▪ Access to Energy
Future Earth Initiative	Worldwide	▪ Improved Food Security ▪ Water Extreme Management ▪ Adaptation to Climate Change ▪ Access to Energy
EU-Africa Research and Innovation Partnership on Food and Nutrition Security and Sustainable Agriculture	28 EU member states and African Countries	▪ Improved Food Security ▪ Adaptation to Climate Change

3.4 Regional Challenges

GEO-CRADLE has followed a structured approach to capture the challenges faced by the countries in the NAMEBA region. Thus, drawing on end user needs, identified gaps, country maturity indicators as well as country proposals, we have developed a National Priority Framework that would allow us to identify national priorities and devise an overall regional priorities action plan. The implementation of this methodology is extensively described in a dedicated deliverable "Priorities Action Plan".



The challenges that stood out in our analysis, were centred around four thematic areas: (i) adaptation to climate change, (ii) improved food security, (iii) access to raw materials, (iv) access to renewable energy resources. On top of these thematic areas, several cross-cutting challenges were assessed, ranging from strengthening of human capacity, to raising awareness among stakeholder communities about the value and benefits of EO services and data, and improving the implementation of data policy principles towards free and open data sharing at national and regional level. Eventually this process gave rise to a set of feasibility studies that were developed and implemented over the duration of GEO-CRADLE with the aim to address some of the most pressing challenges. More details on these studies are provided below.

3.4.1 The GEO-CRADLE Feasibility Studies in response to regional challenges

GEO-CRADLE identified common needs and regional priorities over the diversified territories of NAMEBA and showcased concrete ways of tackling regional challenges through the following feasibility studies:

1. Adaptation to Climate Change
2. Improved Food Security - Water Extremes Management
3. Access to Raw Materials
4. Access to Renewable Energy Resources - Solar Energy

These pilot activities have built on the integration of available capacities (infrastructure, datasets, models, etc.) and skills to provide improved EO Services in the RoI. They serve real needs of end-users and support the achievement of the UN Sustainable Development Goals (SDGs), as shown in the Figure below.

All data and applications have been registered and are available online with free and open access at the GEO-CRADLE portal (http://geocradle.eu/en/regional-capacities/feasibility-studies/) as well as at the GEO-CRADLE Regional Data Hub (http://datahub.geocradle.eu/).

Figure 17: The four feasibility studies of GEO-CRADLE and their connections with the UN SDGs.

Adaptation to Climate Change

The ACC pilot provided the necessary support and coordination to existing infrastructures in order to deliver consolidated information and knowledge for the long term strategic planning on adaptation and mitigation to climate change and air quality, which are of high importance for the RoI. The pilot paved the ground for the holistic monitoring and forecasting of region-specific atmospheric components, ECVs and hazards, in line with the standards and vision of GEOSS and Copernicus for information extraction and service delivery regarding the Climate SBA. Specifically, it provided the following 3 services on respective thematic pillars:

1. Desert Dust services

A large scale feasibility study was conducted to represent the dust forecast capabilities, strengths and weaknesses over the AoI. The study took place during PRE-TECT campaign 1-30 April 2017 in Crete. A suite of state-of-the art atmospheric dust models has been operating during this period for the provision of forecasting fields for the columnar load of dust and the vertical distribution of dust layers.

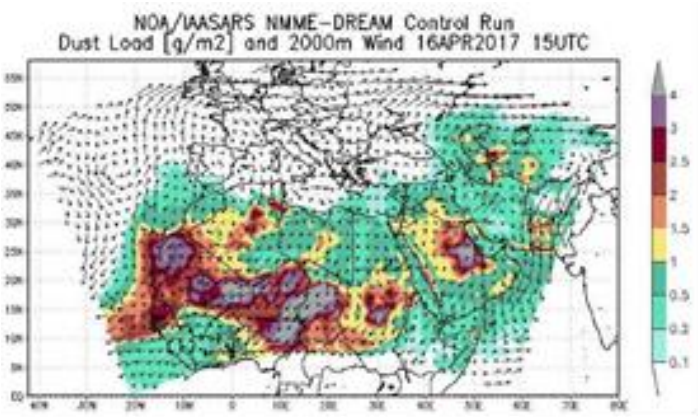


Figure 18: PRE-TECT dust forecast: NMM-DREAM control run with NCEP/GFS initial and boundary conditions.

The importance of GEO-CRADLE dust service activities has been highly recognized by end-users from public authorities, academia and private sector, including: The Algerian Meteorological Office, The Ministry of Electricity and Renewable Energy of Egypt, The Kuwait Institute for Scientific Research, The

Department of Meteorology in Cyprus, Balloonera Private Company in Serbia, and the University of Belgrade Serbia.

2. Regional Climate Change services

A user-friendly interactive web application tool was created to support both policy- and decision-makers, as well as stakeholders and end-users for mitigation and adaptation on climate change impacts: the Data Extraction Application for Regional Climate (DEAR-Clima). It visualizes and provides time-series of essential climate variables and climate indices based on high horizontal resolution Regional Climate Model (RCM) simulations from the Coordinated Regional Downscaling Experiment (CORDEX) research program.

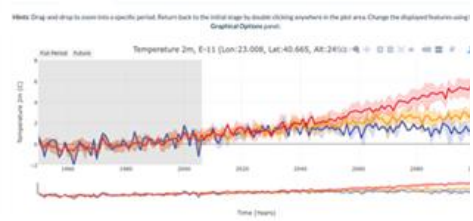


Figure 19: DEAR-Clima plot showing a multi-model ensemble time series from 1950 to 2100 for the change in mean annual near-surface temperature relative to the historical period 1950–2004 for 3 scenarios: RCP2.6 (blue), RCP4.5 (yellow) and RCP8.5 (red).

DEAR-Clima was used to provide various high-resolution climatic data to the following organizations: The Regional Hydrology and Water Resources Sebou Basin Agency (ABHS) of Marocco, The Department of Infrastructure and Rural Development of the School of Rural and Surveying Engineering of the National Technical University of Athens (NTUA), and The Centre for the Assessment of Natural Hazards and Proactive Planning (CANaH) of the National Technical University of Athens (NTUA). It is further indented for intermediary and end-users of the broader public/private sectors of tourism, agriculture, natural hazards and water management.

3. Air Quality services

Under the concept of the exploitation of the air quality forecasts of Copernicus Atmospheric Monitoring Service (CAMS), GEO-CRADLE performed the following activities:

- **CAMS air quality products evaluation.** It was based, on the one hand, on the selected CAMS parameters according to the user needs identified in the RoI, and on the other hand, on data availability from the PRE-TECT campaign. This evaluation is of great importance mainly because the utilized data are representative of the background air pollution in the RoI, and because it involves species not (or poorly) subjected to the official validation procedures of CAMS.
- **CAMS uptake.** It concerned the further exploitation of selected air quality species provided by CAMS services, based on the outcomes of the aforementioned evaluation results.

Improved Food Security - Water Extremes Management

This pilot involved the knowledge transfer of EO tools and practices from countries in the region that are more advanced and mature in the utilization of EO data and uptake of EO services towards countries that are lacking behind, with respect to the improvement of food security and water extremes management.

The state-of-the-art technologies disseminated entail: a) on the hand the development of a regional Soil Spectral Library (SSL) with a total of 1754 distinct soil samples, granted that the region was severely under-represented in other contemporary SSLs, which is necessary for the transformation of EO data to end-user data; and b) on the other hand the combined use of EO data and EO-derived maps with other sources (such as e.g. meteorological and topographical data) in myDEWETRA platform, an integrated web-GIS platform for monitoring of natural risks, projecting potential of risk in the future (forecasting), and evaluating the effect of prevention measures.

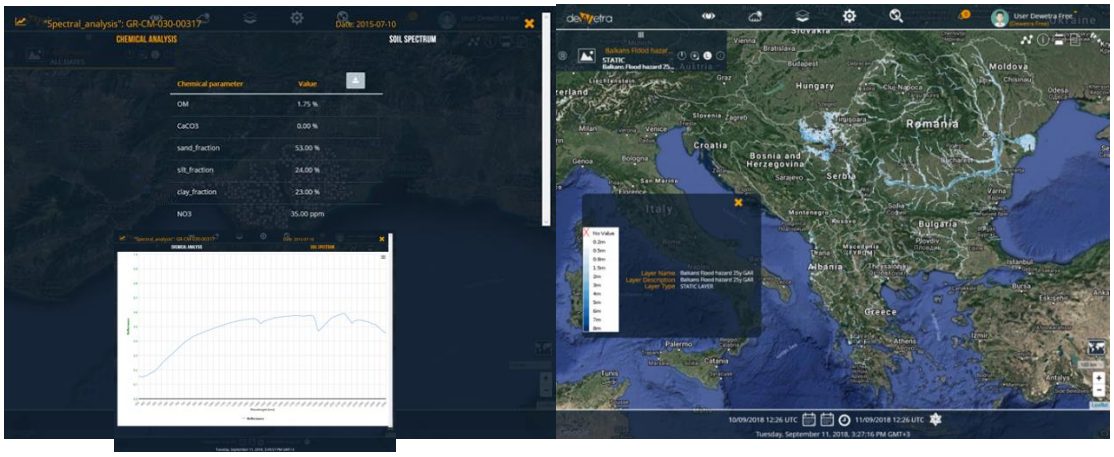


Figure 20: MyDewetra platform. Left: Soil Spectral Library (soil spectrum and chemical analysis). Right: Map of Balkans for 25-year Flood Hazard.

As far as the establishment of the regional SSL is concerned, particular care was taken to ensure that the library conforms and adheres to other spectral libraries, assuring its future extension and compliance with other contemporary libraries. The methodology and techniques used were: a) perform soil sampling (i.e. collect the soil samples), b) prepare the samples and chemically analyze them, c) perform the spectral measurements in a standardized, uniform, and error-free way, d) develop spectral models using machine learning algorithms, and finally e) applying the models to Copernicus EO data. These were all put to the test and culminated through their real-world application, i.e. the establishment of the regional SSL and production of EO-related products utilizing the SSL.

With respect to the management of water extremes, myDEWETRA platform was developed enabling the integration of static and dynamic geo-spatial data (including data derived from EO sources) as well as models for forecasting. It was populated with significant data for the RoI including past weather and climatic data, and forecast results of models assessing the floods and droughts risk. Moreover, products derived from EO techniques were integrated. Besides the general data of the region, a case study was considered, encompassing the Drin river basin in Northern Albania. A hydrological model was subsequently implemented in the region, whereby a comparison was made between modelled soil moisture and satellite soil moisture. The use of clay content maps from satellite data was investigated for the evaluation of the hydrological model's parameters. In addition, two soil maps generated from satellites of the Copernicus mission with the help of the regional SSL were furthermore integrated into the myDEWETRA platform and into the hydrological model of the region, showcasing how the outcomes of this pilot activity may be exploited in the future by other researchers.

The pilot outcomes are relevant to improve decisions of policy makers, concerning agricultural and natural processes in general. It has a strong potential to help EU agricultural policy meeting their objectives, concerning enhanced competitiveness of the agricultural sector and improved sustainability and effectiveness through reduced environmental impacts and utilization of natural resources in more sustainable and highly efficient manners. The end-user and stakeholder engagement included: The Ministry of Economic Development, Tourism, Trade & Entrepreneurship of Albania, The Ministry of Environment of Albania, GEO's Secretariat, The Agriculture Cooperatives of Nestos, NESPAR, Cooperatives of Xanthi, Eleftheroupoli, and Volvi in Greece, and The Golan Heights Winery.

Access to Raw Materials

This pilot activity provided a comprehensive review of the status of remote-sensing applications for mineral exploration, with emphasis on the contributions of satellite-based Copernicus data.

The extensively under-explored areas in RoI expressed the need for requirements to facilitate the access and exploitation of mineral resources for creating well sustained businesses, in compliance with widely recognised environmental protection principles. Therefore, the pilots were chosen with the aim to define the roadmap for long-term monitoring, mapping, and management of mineral deposits, also assessing the ground changes and site degradation relating to mineral exploitation.

Through close cooperation with end-users in RoI, four different examples of pilot sites were defined that allow to establish studies on better monitoring of the mining and post-mining areas and mitigation of their impact: legal and/or illegal quarrying in Greece, improved monitoring in abandoned Asbestos mine in Cyprus, carbon potential investigation and determination of orientation of coal outcrops in Central Anatolian Lignite Basin in Turkey, and determination of the iron potential zones in Celebi Iron-oxide mineralization district in Turkey. The EO methodologies elaborated on the pilot sites have a universal character and can be applied for other RoI as well.

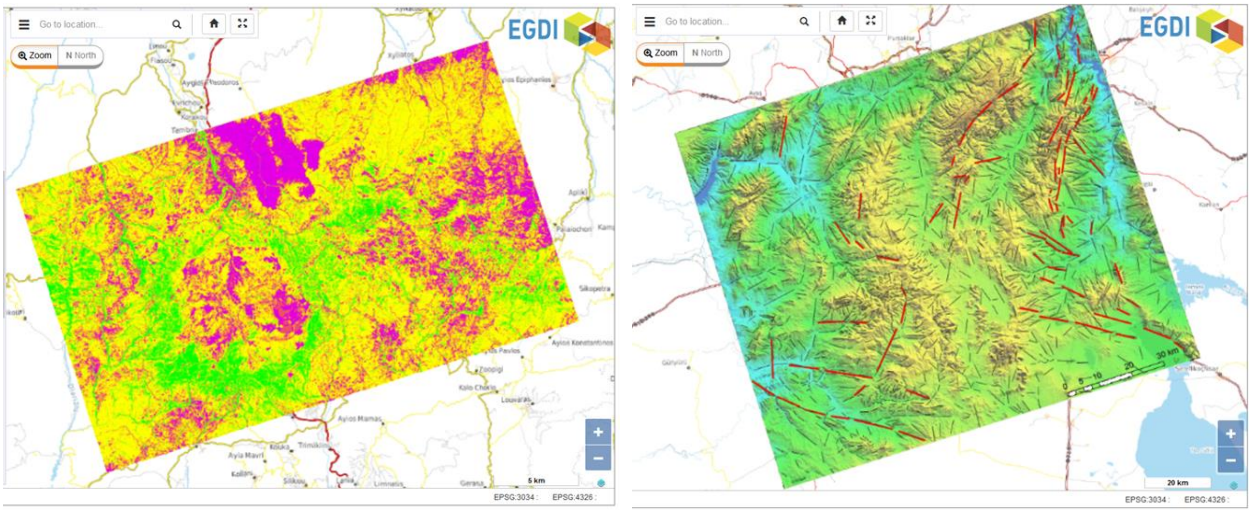


Figure 21: European Geological Data Infrastructure (EGDI) platform. Left: Normalized Difference Vegetation Index (NDVI) calculated from Sentinel-2 image. Right: Lineament map extracted from 5 different techniques based on Landsat-8 image and SRTM.

This pilot activity has established closer collaboration and extension of cooperation with the following end-users: Ministry of Environment and Energy of Greece, Municipality of Alexandroupolis in Greece, the Ministry of Agriculture, Rural Development and Environment of Cyprus, the Hellenic Copper Mines Ltd, the Minister of Energy, Mining, Water and Environment of the Kingdom of Morocco, the Geological Survey of Algeria, JADE - Association of Geological Researches of Turkey, and JeoDijital Bilisim Teknoloji Madencilik in Turkey.

Access to Renewable Energy Resources - Solar Energy

GEO-CRADLE introduced the Solar Energy Nowcasting SystEm (SENSE) pilot in order to coordinate, improve and support the regional EO infrastructures and capabilities related to ''access to energy''. The niche for this pilot is the operational, satellite-driven and real-time system for solar energy nowcasting and forecasting.

The SENSE pilot developed reliable, high resolution solar Atlases and broader climatology studies for the RoI, while it engraved strategy methods of how to integrate such a solar energy nowcasting system into a wider GEOSS driven system in the international scale with multifarious collaborations and carefully selected end-users.

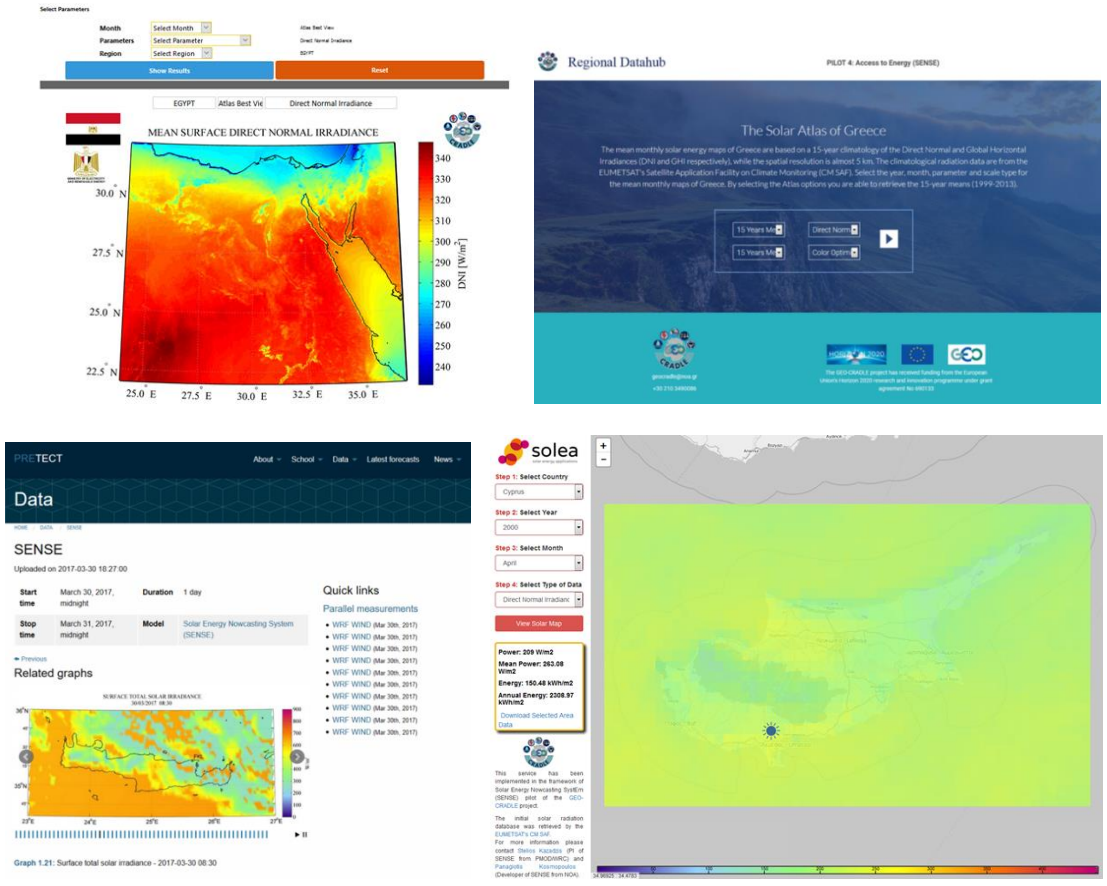


Figure 22: SENSE pilot products. Up left: Solar Atlas of Egypt. Up right: Solar Atlas of Greece. Down left: Solar energy maps of Crete during the Pre-tect campaign. Down right: Photosynthetically Active Radiation (PAR) Atlas for Cyprus (available also for Greece and Egypt).

The SENSE pilot stimulated the interest of relevant energy stakeholders, decision makers and other end-users like the following:

- Egyptian Ministry of Electricity and Renewable Energy: A common website was developed for the dissemination of the real-time and climatological solar energy products of SENSE. Moreover, an analytical Egyptian Solar Atlas Book was published.
- The Greek National Independent Power Transmission Operator: A close collaboration was established in order to update their nowcasting and forecasting power systems with the SENSE's state-of-the-art methods and techniques. They exploit the real-time solar energy maps and data (60K pixels/integrated energy values every 15-minutes) by comparing them with real solar farms and controlling the local energy demands.
- Pre-tect campaign: The solar energy maps of Crete were provided in real-time for the purposes of the campaign and spectral comparisons were made with a high precision solar spectroradiometer (PSR) in order to further validate the SENSE under high-aerosol loads.
- Attica Group with Bluestar and Superfast Ferries: For the pilot period they attracted relevant ads in order to efficiently advertise the real-time UV-index service from SENSE through the monitors of their ships with routes to the Aegean and the Adriatic sea.
- The National and Kapodistrian University of Athens (NKUA): The mean hourly Photosynthetically Active Radiation (PAR) was provided for all months of 2016 in order to estimate the magnitude of Non-Methane Volatile Organic Compounds emissions emitted by vegetation over Greece.

3.5 SWOT

During its 3 years of activities, GEO-CRADLE has managed to put together a thorough picture of the current state-of-play of EO activities in the NAMEBA region. Through multiple contacts with the actors of the local ecosystem and following a solid methodological approach (inventory, user need analysis, gap analysis, maturity indicators) we were able to identify many of the commonalities and differences that drive the evolution of the EO sector in the region. Having "*put our finger on the pulse*" of the region we can confidently report that this pulse is strongly beating. At present, the region stands at a point where it can

- **Build on its strengths** through targeted capacity building and by exploiting cross-fertilisation effects between organisations, programmes and countries
- **Address its weaknesses** through coordinated work across sectors and borders
- **Realise the opportunities** arising from the need to address region-specific challenges and going along the overall thirst for progress and sustainable development
- **Protect against threats** such as geopolitical instability and budgetary cuts, using the lessons learned over the past few years

Thus, as a takeaway for the next chapter where we shall be studying where do we want to be, we present the high-level SWOT for EO activities in NAMEBA region.

STRENGTHS	WEAKNESSES

▪ Existence of organisations driven by excellence and operating across borders and regions ▪ Significant scientific output in several thematic sectors ▪ Past years' challenging conditions have built strong resilience in the EO sector and have honed its entrepreneurial and scientific excellence potential	▪ Often very limited technical capacities, not only wrt observational systems but also basic infrastructure ▪ Limited networking both within and across countries ▪ Public-sector dependence, bureaucracy and red tape ▪ Limited awareness of EO benefits leads to disconnect from policy implementation & decision making ▪ Lack of sustainability/operationalisation orientation
OPPORTUNITIES	**THREATS**
▪ Thirst for new technologies towards progressing national maturity and address regional challenges ▪ Plethora of complementary programmes providing funding for cross-border collaboration ▪ Collaboration mentality becoming stronger as countries realise its power and necessity ▪ Markets ripe for innovation and entrepreneurship	▪ Regionally sensitive balances, country disputes ▪ Vulnerability to financial crises and geopolitical instability ▪ Discontinuity or re-direction of funding ▪ Often lack of skilled and trained workforce ▪ Linguistic, cultural and organisational differences hindering effective knowledge transfer

Figure 23: SWOT diagram for EO in NAMEBA region

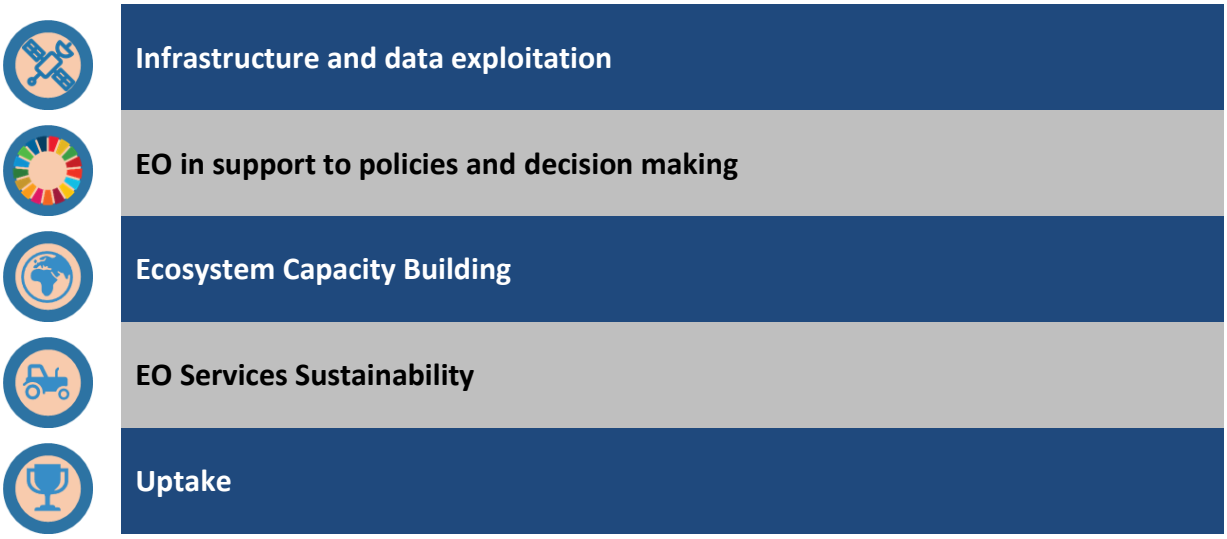
This Copernicus Sentinel-2 image features Tunisia's capital Tunis, in North Africa, and highlights some of the country's important wetlands.
Released 02/02/2018

4 Where do we want to be?

This chapter lays out the different aspects of the desired progress in the region with regards to better implementation and uptake of GEO/GEOSS and Copernicus. In that respect, here we focus on the destination itself, whereas the different aspects of the journey to get there are discussed in the next chapter. The presentation of "**where do we want to be"** builds on the findings of the previous sections and is directly informed by the strengths, weaknesses, opportunities and threats applicable to the region. Furthermore, it is inspired by the insights provided by various experts either in dedicated interviews or in targeted workshops (in particular the outcomes of the 3rd South-Eastern Europe GEO Workshop, and the special side event organised by GEO-CRADLE during the GEO Week in Kyoto). Finally, the discussion is strongly driven by

- National policy priorities and the strategic vision of individual countries
- Key policy priorities/objectives laid out in relevant EU directives, strategic documents (e.g. Space Strategy for Europe) and international partnerships (e.g. 2030 SDG Agenda);
- The need to leverage past, ongoing and planned investment towards maximising their impact on the region
- The need to establish sustainable activities – or at least activities with a long-lasting impact.

Combining all these inputs we are attempting to envisage a future for EO activities in the NAMEBA region that whilst being ambitious is also realistic. With that in mind we set out below to systematically present where do we want to be along five main dimensions:



In the following, we break each of these dimensions down to smaller components, discussing the desired scenario of where we want to be.

4.1 Infrastructure and data exploitation

The development and sustainable operation of EO-related infrastructure is an essential prerequisite for the increased output of the region both at scientific and business-oriented level. Thus, the ability to collect, store and process multimodal EO data is directly connected to the level of observational and data exploitation capacities. International initiatives (e.g. Copernicus, GEOSS) not only provide the framework within which national EO capacities can be developed, but also the necessary impetus to do so (via funding, training and data sharing advocacy). Yet, enhanced infrastructure and improved data exploitation relies on national-level decisions, in particular for funding towards sustained operations. In that context, the desired future of the region would see improved and sustained capacities (incl. basic infrastructure), a higher degree of integration between countries and across sectors, and a widespread data sharing mentality. At the end of the line, the region would be in a position to augment its contributions to the GEOSS Platform and other data gateways.

4.1.1 Improved and sustained “basic” infrastructure

Description: The exploitation of EO data does not only rely on advanced payloads on satellites, in-situ observation networks and big data techniques. At the very limit, it requires the availability of a steady internet connection with large enough bandwidth to download and process EO datasets, or to allow an EO-based application to be used on the field. At the advent of the big data era, it also requires cloud storing and computing capabilities which an individual university, public service body or let alone SME can not easily afford. Therefore, realising a future where better exploitation of EO data is possible, requires the development and sustainable operation of “basic” infrastructures.

At the same time, as widely reported during GEO-CRADLE gap analysis, it is essential that existing infrastructure is properly maintained especially when it comes to in situ networks that provide valuable local or regional data complementary to the remotely sensed ones. Thus, concerted efforts are required to not only upgrade the observational capabilities in the region but at the minimum to sustain the existing ones.

4.1.2 Integrated capacities allowing effective observation of different environmental systems

Description: GEO-CRADLE is the project developed and executed in response to the SC5-18b-2015 topic calling to "Integrate North African, Middle East and Balkan Earth Observation capacities in GEOSS". In that regard, the project has provided a hands-on proof of concept, of the importance, challenges and impact associated with the integration of observational, modelling, processing and human capacities in 4 thematic areas. Such an integration requires a firm understanding of which capacities exist where (see GEO-CRADLE inventory) and a concrete vision of the technological and scientific interfaces that need to be built so that complementary capacities are jointly used to address regional challenges. A harmonised landscape in terms of data platforms and gateways – using common architectural standards – is of outmost importance for such an integration effort to work.

Aside from the technical aspects, the integration of capacities should not be done in an *ad hoc* fashion (e.g. triggered by an R&D project lasting for a few years); instead it should be informed by a sustained process whereby the relevant stakeholders are fully aware of the applicable challenges and are able to set out concrete objectives (i.e. planning ahead and actively seeking synergies with other countries).

4.1.3 Widespread data sharing mentality

Description: The true value of Earth Observations relies on the combination of different data sources into products and services that can enable informed decision making across numerous thematic sectors. In that regard, the ability to easily access and process data collected from space-borne or in-situ sensors is essential. Copernicus has been spearheading this approach with its free, full and open data policy. At the same time, GEO has been strongly advocating across the globe on the necessity of the adoption of its data sharing and data management principles. In parallel, the EU has been heavily promoting the implementation of the INSPIRE directive – an effort geared towards helping to make spatial or geographical information more accessible and interoperable for a wide range of purposes. These three pillars ultimately support sustainable development – a domain of utmost importance for most countries in the NAMEBA region. Yet, as strongly documented throughout the execution of GEO-CRADLE activities, there is a significant lack of data sharing mentality among key actors in the region (even within the same ministries).

In this context, building a future characterized by extensive EO data exploitation relies very heavily to the widespread adoption of data sharing principles and the harmonization (in terms of standards) among organisations and countries.

4.1.4 Enhanced regional contribution to GEOSS Platform and other data gateways

Description: The GEOSS Platform (formerly GCI) is the *de facto* gateway that "proactively links existing and planned observing systems around the world and supports the development of new systems where there are gaps". In this respect, prior to the implementation of GEO-CRADLE, a significant "gap" existed with regards to datasets of regional relevance and importance from NAMEBA being linked to the GEOSS Platform. The implementation of the GEO-CRADLE Regional Data Hub (RDH) has been a milestone in that direction, identifying and linking numerous datasets from the region onto the GEOSS Platform. Beyond augmenting the reach of these countries within GEOSS and vice versa, the RDH has been a pillar for the advocacy on data sharing principles and a node for the creation of an ecosystem of data holders, scientists, data users, and entrepreneurs. This latter point becomes even more critical when one considers the impact expected by the implementation of the Copernicus Data and Information Access Services (DIAS) towards establishing a vibrant EO data exploitation ecosystem not only in Europe but also globally. With Copernicus being the *de facto* driver for EU's contribution to GEOSS and with EuroGEOSS being the main vehicle for this contribution to be organised and maximised, it becomes apparent that having an enhanced contribution of data from the NAMEBA region is fundamental.

The success in the implementation of the RDH, but also the lessons learned in that process, offer a concrete path for such a future to be realised, albeit at a much wider scale.

4.2 EO in support to policy implementation and decision making

Informing decisions and actions for the benefit of society and economy through coordinated, comprehensive Earth Observations lies at the core of GEO and Copernicus alike. In practice, both programmes promote international collaboration towards the development of EO-based products and services that offer timely and accurate information to a wide range of actors. Thus, whether informing a farmer about the variability of their field and associated practices to increase its productivity; helping civil protection authorities monitor the evolution of a natural disaster and make timely interventions; enabling an entrepreneur investing in renewable resources to make the most of their investment; or supporting road infrastructure managers in the planning of their development projects, are but a few of a myriad of cases where EO enables informed decision making. Many of these cases are associated with or fully incorporated under the implementation of national policies or international directives. In that regard, EO is not only helping the practitioners themselves but the policy makers too. Thus, a coordinated adoption of EO solutions within national and international policy frameworks is of utmost importance, especially in a region such as NAMEBA where the need for sustainable development is high.

4.2.1 Greater uptake of EO solutions in support of international directives and national priorities

Description: EO has an immense potential as an enabling tool for the effective implementation of international directives and national priorities. For the former, the EU has shown the way forward through the explicit linkage of Copernicus/EO-based solutions with the implementation of key policy frameworks such as the Common Agricultural Policy and the EU's Water Framework Directive. For the latter, the delivery of the Copernicus Core Services themselves, but also the downstream services developed on the basis of Copernicus data, is progressively more embedded within the workflows of key public service bodies monitoring or reporting on national priorities. This is often supported in Europe by nationally-driven programmes such as the Space for smart government in the UK and equivalent ones in the Netherlands or Germany. Whilst this overall context is not equally applicable to the non-EU countries in the NAMEBA region, the interfaces to ensure the appropriate knowledge transfer and capacity building are being set up. Thus, the envisaged future of EO activities in NAMEBA would see a much greater integration of EO solutions within the implementation of policies. Ideally, this would not only be done in a top-down fashion (i.e. the equivalent of international directives) but also bottom-up (i.e. in direct service of national policy initiatives).

4.2.2 Systematic incorporation of EO in SDG monitoring and reporting

Description: The 2030 Agenda on Sustainable Development Goals, offers a unique framework within which concerted actions will be undertaken to address key environmental, societal and economic challenges. The effective monitoring of the SDG Indicators, as well as reporting of the progresses towards the SDG Targets, require the combination of different types of data. This goes well beyond the traditional socio-economic data that countries have been exploiting to assess their development policies, such as household surveys, population census and other types of administrative data collections. In this context, Earth Observations, together with modern big data processing tools, offer unprecedented opportunities to modernise the national statistical systems and consequently to make a leap in the capacities of countries to efficiently track all facets of sustainable development.

Thanks to its global spatial coverage and the high frequency of observations, satellite-based EO can prove essential in capturing important aspects of sustainable development and support the implementation of SDGs. If such capacities are effectively integrated within the national reporting processes (primarily connected to the work of National Statistical offices and the associated line ministries), EO can also significantly reduce the monitoring costs and consequently enable countries to meet their engagement to monitor and report progress on the Goals and the Targets.

All in all, the envisaged future would find EO effectively exploited for the monitoring and reporting progress on the SDG Targets both at national and global levels, benefitting from the wealth of data made available from programmes such as Copernicus but also through regional datasets sourced locally.

4.3 Ecosystem Capacity Building

The effective delivery of benefits enabled by EO-based services relies on the capacity of users to integrate the provided information into their operational workflows and for service providers to design, develop and deliver solutions that effectively meet user needs. Building such capacity starts with the systematic engagement of users from the very beginning of the design process, to capture their exact operational needs (in terms of resolution, frequency, delivery format, etc.) and limitations, and transform them into a set of specifications that dictates the delivery of the EO-based services. Whilst such co-design processes have been recently receiving increasing recognition, a truly systematic user-driven approach for the design and delivery of EO services is yet to be adopted. A future that fully incorporates such approaches would also see a significant upgrade in the overall EO maturity at national level, and in particular a strengthened value chain, whereby the various different links would be more tightly knit. A more robust EO ecosystem would also better support "non-EO capacity building", i.e. the overall execution of sustainable development projects across the NAMEBA countries.

4.3.1 Enhanced EO maturity at national level

Description: The execution of effective actions towards enhancing the EO maturity of each country requires first and foremost a solid knowledge of current strengths and weaknesses. Given the dynamic evolution of the EO sector as a whole but also the strides of general progress that some of the countries in NAMEBA are making, maintaining this knowledge over time is essential. In practice, an up-to-date assessment of national EO maturity would allow decision-makers and other stakeholders along the value chain to prioritise actions, mobilise resources and concentrate efforts towards appropriately building on strengths or addressing weaknesses. With time it also enables them to better understand the impact of different activities and proceed onto corrective actions if necessary. Thus, an envisaged future of enhanced EO maturity at national level is directly tied to coordinating actions along the fleeting present using accurate knowledge of where it stands.

4.3.2 Effective integration of demand and supply sides

Description: The successful evolution of the EO sector as a whole will be achieved if a fundamental paradox that currently applies is overcome. This is related to the fact that whilst the true value of EO lies in its ability to support decision making for a multitude of different users, the actual needs of the users are seldom appropriately incorporated in the design of EO services. Instead, the uptake of EO is primarily driven by "technology push" processes. It is therefore essential that the envisaged future is carved through targeted capacity building efforts that empower both demand and supply sides towards understanding and addressing each other's realities.

4.3.3 Integrated value chain where each link is working well with the rest to exploit each other's competencies

Description: A value chain whereby each link is operating in relative isolation is a significant blocking factor for the full realisation of EO-based benefits for society and economy. Scientists focussing only on R&D projects; companies pushing their latest technological solution without true regard of user workflows; users unaware of the benefits and practical aspects of different EO solutions; governmental organisations impaired by bureaucratic processes, are all signs of a dysfunctional value chain. This is why the desired future for EO activities in NAMEBA would need to see a completely different picture than the grave one described above. Such an "ecosystem capacity building at large", would be exploiting the multiplier and networking effects of programmes such as Copernicus and GEO. But, ideally, it would also go beyond that, integrating EO value chains to the non-EO ones, in the downstream sectors of relevance (e.g. agriculture, water management, renewable energy, etc.).

4.3.4 Stronger positioning of EO as an enabling tool in support of Sustainable Development (non-EO capacity building)

Description: Sustainable development is to a large extent pursued through the implementation of Official Development Assistance (ODA) projects, (co)financed by International Financing Institutions (IFIs). Such projects promote capacity building in different sectors with no special provision for the user of a specific technology. Yet, the prospect for EO-based products and services to be used as 'best-practice' environmental information, mainstreamed into the working processes of international development, has been long recognised and is now progressively realised in efforts such as ESA's EO4SD. In that regard, and with a generally better built EO ecosystem (see points above), the envisaged future would see the use of EO-based information as a systematic source of environmental information planned and provisioned in the financial resources and operational working practices for all phases of international development projects; i.e.: Identification, Preparation, Appraisal, Negotiation, and (most importantly) Implementation.

4.4 EO Services Sustainability

Delivering the benefits enabled by EO to citizens, businesses and governments, requires that the EO sector as whole moves from a data- to a user-driven approach and subsequently to sustained development and delivery of EO services. To pursue the sustainability or commercialisation of their EO services, researchers, start-ups, SMEs or larger companies require access to four key resources: (i) access to knowledge, (ii) access to technology, (iii) access to markets, and (iv) access to capital. The intensity of support needed across these four resources varies depending on the stage of development of an EO service. Thus, when looking at the "journey" of an EO service from idea to market expansion – depicted here below (credit: Evenflow) as a conveyor belt, each resource is needed at different rates. Therefore, the envisaged future of EO activities in the NAMEBA region, would see an increased provision and exploitation of such resources towards translating R&D to innovation and eventually building a sustainability culture.

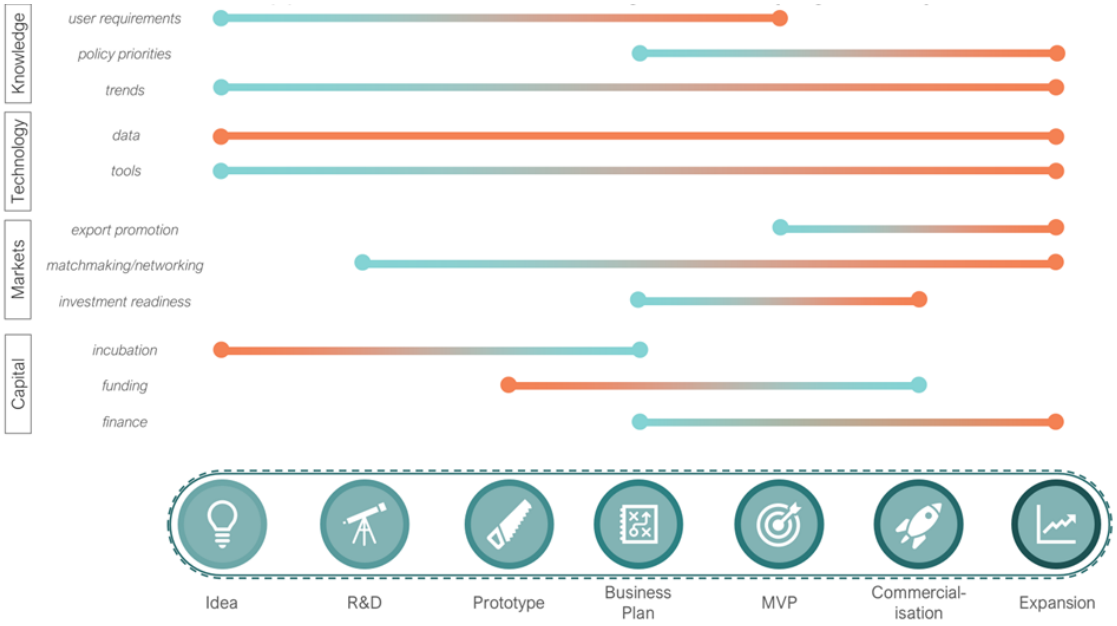


Figure 24: The varying levels of intensity for the provision of sustainability support across the conveyor belt

4.4.1 Effective translation of R&D work into innovative and eventually operational services

Description: Although not uniquely applicable to it, the NAMEBA region has seen a long series of R&D projects being implemented, producing excellent results but not being further exploited. Sectorial users and governmental organisations alike get a taste of what is possible – often enjoy receiving it for free over the project's lifetime – but then are unable or not appropriately aided to carry it forward on a sustainable basis. This is often connected to the discontinuity of funding for projects and the inability of those executing them to find appropriate post-project exploitation paths. As far as Copernicus is concerned, a comprehensive effort is currently being undertaken within the Copernicus Start-up programme, for the systematic provision of business support to spin-offs, start-ups and SMEs. Accelerators, Competitions and Incubation Programmes offer much needed support, as do – although rarely – private investors. Nonetheless, even in the EU where EO maturity is generally higher than the NAMEBA region, very few start-ups have achieved a real breakthrough into the market, and very rarely are R&D results of project truly being exploited. All this contributes to the – perhaps surprising – reality where there is still a long way to go to create a critical mass of operational cases of EO utilisation. GEO is also putting greater interest in this dimension – at least in Europe – by launching a dedicated call on the "development of commercial activities and services through the use of GEOSS and Copernicus data".

With these effects being decisively more pronounced in the less mature parts of the NAMEBA region, moving from "one-off" demonstrations of EO capabilities to a sustained delivery of EO services becomes an imperative. Thus, the desired future uptake of Copernicus and GEO in the region would entail concerted efforts to move from R&D to operational EO services delivery.

4.4.2 Established "pipeline" for design, development and delivery of operational EO services that meet user needs

Description: The recent launch of the EuroGEOSS initiative underlines the current shift from a data- to a user-driven approach. This is certainly connected to and inspired by the long-standing user-centric philosophy of Copernicus. It is also strongly driven by the need (see discussion of this point above) to foster the development and delivery of operational EO services that meet user needs. Aided by ecosystem capacity building activities (see 4.3) the future implementation of Copernicus and GEO in the region would be delivered through the establishment of a "pipeline" whereby different actors in the value chain are working together with a clear sustainability orientation, whilst they are also supported at international and national level with the necessary resources to make this work.

4.4.3 Improved industrial cooperation and overall output of industrial sector

Description: The gap analysis of GEO-CRADLE has underlined the relative underdevelopment of the private sector in the NAMEBA countries. At the same time, the activities of GEO-CRADLE have offered strong evidence that the local markets are ripe with business opportunities, even if realising them requires a persistent approach. This was well exemplified by the keen interest of European EO companies to understand and pursue business opportunities in NAMEBA, following the "Industry Workshop" organised in April 2017. Many of these companies have built strong networking with key actors in the region resulting in successful bids against international tenders but also direct B2B contracts. Whilst these considerations highlight the prospects for industrial cooperation in the region, it must be noted that GEO-CRADLE was not structured as such to provide this type of support. It was rather a side-effect of its strong networking capabilities. Yet, acknowledging that both Copernicus and GEO offer a platform for international cooperation between businesses, users and researchers, it becomes apparent that their future uptake could also be connected to an improved environment for industrial cooperation.

4.5 Uptake

The successful uptake of EO relies on the design and implementation of a suite of activities that are tailored to the "realities" of the targeted stakeholder groups. This concerns both the means (i.e. events, online material, training sessions, etc.) and the messages delivered through them. In that context, a comprehensive Copernicus and GEO uptake approach for the NAMEBA region, would include a wide range of interventions, targeting a multitude of actors at sectorial, national/regional and international level. It would also entail specific liaison activities with key communities (e.g. UN-SDGs, IFIs, PRIMA, EIPs, etc.) within the greater EO ecosystem but also among non-traditional actors (e.g. Industrial associations representing primary application sectors of EO). Such an approach would lay down robust foundations for an enhanced awareness of EO-driven benefits in different downstream sectors; an increased participation of countries and key organisations therein in GEO and Copernicus activities; and a better traction between EO and non-EO initiatives. This is exactly the destination where we want to arrive.

4.5.1 Enhanced awareness on EO-driven benefits for different downstream sectors

Description: EO can provide significant benefits to numerous downstream sectors: agriculture, urban planning, disaster management, climate change adaptation, transport, forestry and tourism are just but a few of these sectors. Yet, the awareness levels among key end-user organisations of what EO can offer are – in most cases – rather low. Therefore, considering the needed shift to an overall user-driven approach, it is imperative that such organisations gain a much more thorough understanding not only of the technical characteristics of EO products and services but also of the socio-economic benefits (ideally in concrete terms) associated with their use.

4.5.2 Increased participation in GEO and Copernicus activities, as well as involvement in other international initiatives

Description: Being actively involved in the GEO and Copernicus ecosystems has a significant short-, medium- and long-term impact not only to individual organisations but also countries as a whole. Whether considering the exploitation of or contribution to the wealth of EO data; the opportunities for knowledge transfer and capacity building; or the synergistic effects of international collaboration towards scientific and technological excellence, participating in these programmes can be a true booster for the increased EO maturity in NAMEBA. In that respect, the envisaged future would see a much more dynamic and well-targeted involvement in GEO Flagships, initiatives and community activities, Copernicus services and international programmes alike.

4.5.3 Increased uptake of EO in non-EO programmes and initiatives

Description: "Breaking through silos" is not only one of the latest trends in the exchanges between stakeholders involved in international programmes; it is also a fundamental necessity for the EO sector to scale up its activities and maximise their impact. Going hand-in-hand with the general requirement for enhanced awareness of EO benefits across downstream sectors, the practical adoption of EO within the programming, planning and implementation of non-EO programmes is an essential step forward. In that respect, the desired evolution of Copernicus and GEO uptake in the NAMEBA region would entail the explicit incorporation of EO as an enabling tool to achieve objectives set out in different sectors. Thus, in the future, water management, food security, climate change adaptation any several other sectors in which influential entities are driving progress (e.g. FAO, IPCC, IFAD, etc.), will be benefitting from the sustained use of EO.

4.5.4 Long-term, cross-border strategy for the uptake of EO in response to regional challenges

Description: Carving a future whereby all the previously discussed aspects are effectively addressed is a very complex process. It requires the effective collaboration of many different actors, across many different disciplines and beyond the strict national borders. Setting priorities, agreeing on timeframes, leveraging investments, all the while ensuring good communication between the different actors and avoiding fragmentation and overlaps is a challenging endeavour. Its success is therefore directly dependent on shaping a joint, long-term vision that will guide the implementation of the various activities. Simply put, achieving the realisation of the future we have tried to draw with all the previous points, requires a long-term, cross-border strategy.

This beautiful, natural-colour image from Sentinel-2A on 18 September 2015 features the small nation of Bahrain and parts of eastern Saudi Arabia. Released 22/01/2016

5 How to get there?

In the previous chapter we have attempted to lay out the different aspects of the desired future for the implementation of EO activities in the NAMEBA region. We have not however yet discussed how we can get there. Which are the concrete actions that need to be undertaken? Who should be involved in carrying them out and who is going to be mostly impacted? What are the applicable timeframes? All these questions are the subject of this final chapter of the GEO-CRADLE roadmap for the future implementation of GEOSS and Copernicus in NAMEBA. But before we set out to detail the different proposed actions, let us briefly underline the guiding principles that underpin their conception and implementation.

5.1 Guiding principles

The GEO-CRADLE Roadmap and associated action plan are not developed in a vacuum. Instead in proposing a set of actions below we seek to exploit **synergies and cross-fertilisation (P1)** at several levels

- ***Lessons learned and best practices from past and ongoing projects and initiatives***. Combining the internal, far-reaching experience of several GEO-CRADLE partners who have played or are playing instrumental roles in key regional initiatives (e.g. AfriGEOSS, Beyond, EuroGEOSS, PRIMA) and utilising the external insights provided by the Advisory Board and by highly-recognised interviewees and workshop participants, we seek to propose actions that are informed by a wide range of lessons learned.
- ***Alignment with EC and GEO priorities/vision***. The action plan has been conceptualised in close relation to the overarching strategic objectives of GEO and Copernicus uptake.
- ***Cross-border collaboration***. Building on the experience acquired through the 3 years of the implementation of GEO-CRADLE, we place strong emphasis on the power of cross-border collaboration towards the design and execution of actions that will help carve a desired future.
- The proposed action plan is **impact driven (P2)**; it is conceptualised in a way that allows (1) addressing the aspects laid out in chapter 4 (resulting from a long and thorough process of consultation and research), (2) ensuring that realistic perspectives (documented during GEO-CRADLE's lifetime) are blended with a level of ambition that can pragmatically drive progress, (3) providing recommendations for the assessment (and boost) of long-term impacts.
- The action plan has been shaped combining a **top-down and a bottom-up approach (P3)**. This entails tailoring of the GEOSS and Copernicus implementation strategy to regional, national and local needs (top-down), but also fostering the coordination of national and regional activities and their linkage to the greater strategic view of GEO and Copernicus (bottom-up).

We truly hope that this action plan (and the roadmap as a whole) will act not as a "one-off" project deliverable but rather as a trigger towards actual action that can bring a **lasting and sustainable effect of GEO and Copernicus in the region**.

5.2 Action Plan

In this section we present the action plan for the future implementation of GEOSS and Copernicus. This entails a series of recommended actions that will help in realising the future we have drawn in chapter 4

(Where do we want to be?). The suggested actions are directly addressing the various "destinations" we described against the five main dimensions:

- Infrastructure and data exploitation
- EO in support to policy implementation and decision-making
- Ecosystem Capacity Building
- EO Services Sustainability
- Uptake

For each of the actions we discuss who is to be involved and/or impacted among four main stakeholder categories: industry, scientists, users, policy makers.

Moreover, we make a clear distinction of actions in terms of applicable timeframes. Thus, we propose

- "Quick-win" actions primarily targeted at "low-hanging fruit". These are to be pursued in the next 1-3 years.
- Mid-term actions that should be implemented within the next 3-6 years, either because they rely on the success of the "quick-wins" or, simply, because they cannot be realistically met beforehand.

Finally, we present the desired *status quo* by 2030. The choice of 2030 is primarily driven by the programming lifetimes of major international efforts such as the 2030 Sustainable Development Agenda but also the equivalent national programmes that many countries in NAMEBA have adopted. An overall 12 year span (from the time of writing) provides in our view a realistic timing for meaningful progress – after all in the EU, which has been recently celebrating the 20 years of Copernicus since the Baveno Manifesto, several similar challenges as those faced by NAMEBA are still at the epicentre of Uptake programmes.

With all this in mind, we proceed with presenting the visualised overview of the action plan, followed by a discussion of each action under the five main dimensions presented therein.

5.2.1 Overview

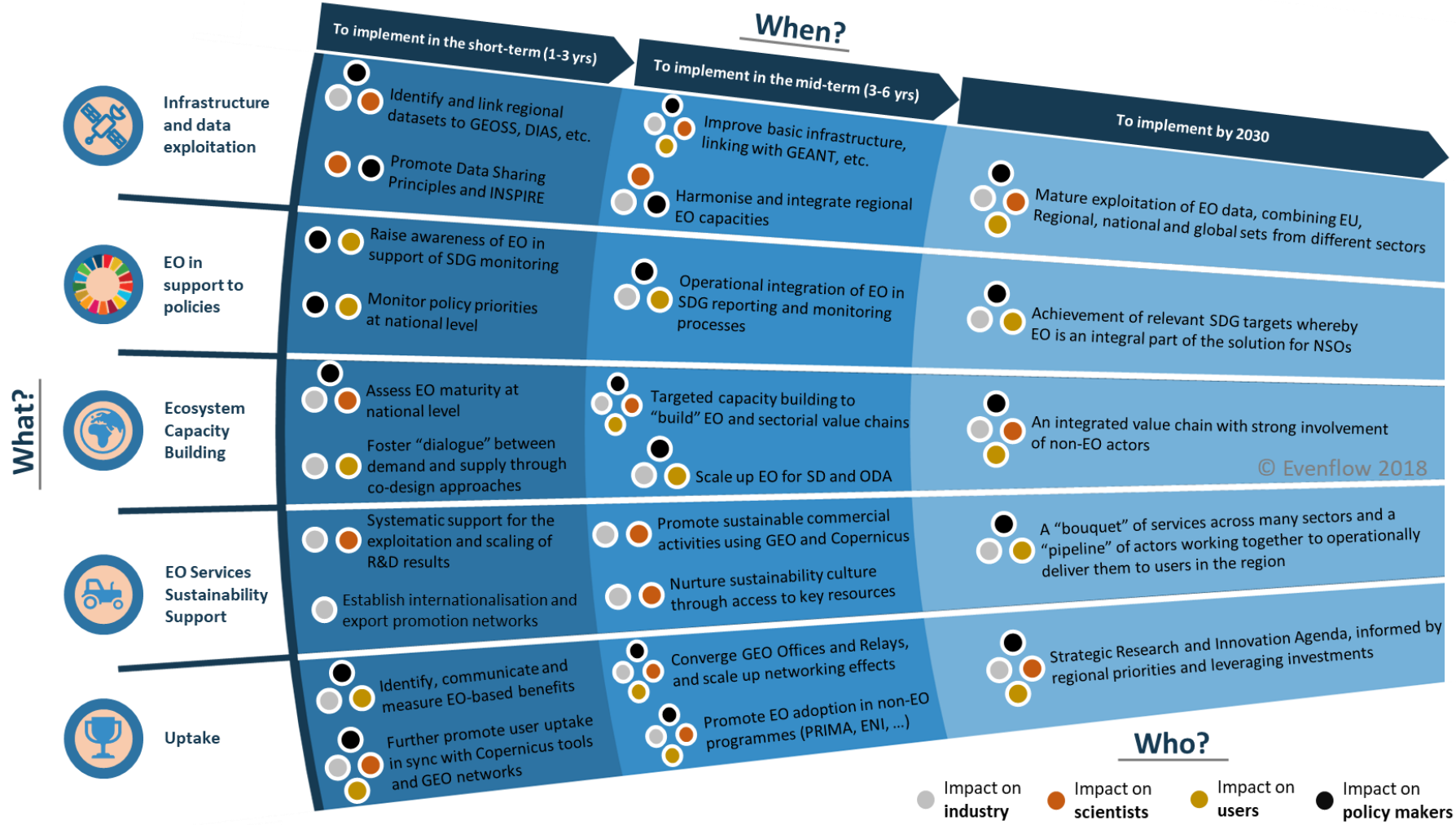


Figure 25:The GEO-CRADLE Action Plan for the future implementation of GEO and Copernicus in the NAMEBA region

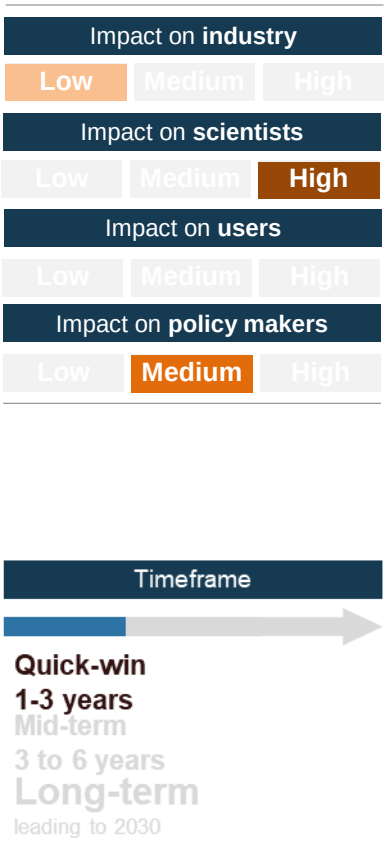
5.2.2 Infrastructure and data exploitation

Action 1: Identify and link regional datasets to GEOSS Platform, DIAS and other data gateways

Description

Building on the work done by GEO-CRADLE in the context of the Regional Data Hub, a concerted effort shall be carried on with regards to the identification, quality assessment and eventual linkage of regional datasets onto the GEOSS Platform (primarily) and other data gateways (such as DIAS or TEPS). Apart from being a service that allows its users to search for (discovery), view (access) and download (request) datasets, portals and services related with the region of Balkans, Middle East and North Africa, the RDH is also currently utilized as a gateway / interface for registering data to the GEOSS Platform. In that respect, it has been highly considered by the GEO Secretariat as a significant pilot operation of a Regional GEOSS Portal. The upgrade of GEO-CRADLE into a GEO Initiative offers the main vehicle to pursue its sustained operation, utilising also synergies with other related actions carried out by NOA (as its operator).

The RDH is a stable service with full interoperability with the GEOSS Platform resources and GEO DAB APIs, and serves as a repository of the data which became available through the project pilots. For its impact to be maximised targeted efforts should be undertaken with regards to assessing the quality of datasets, based on well-defined user/scientist criteria, and related to data integrity, update, information content, availability, and timeliness. Cleaning the existing databases from unused data, uncertain content, and nonfunctioning URLs, etc. as well as promoting the standardized use of metadata is also a critical component of such efforts.



Action 2: Promote Data Sharing Principles and INSPIRE

Description

Promoting Data Sharing principles and associated directives (i.e. INSPIRE) is an essential component towards the uptake of EO and the development of services for the benefit of the various users. In that regard, GEO-CRADLE has provided a concrete **proof-of-concept for the value of regional data hubs and their role not only as a gateway to data but also as an active advocate/interlocutor for open data sharing**. Thus, it is strongly recommended that such efforts are scaled up and replicated, **building on the paradigm of the GEO-CRADLE RDH**. This has been set up with free and open access, serving to facilitate the access of the regional actors and EU partners to useful datasets and portals from the regions that use open standards. It is an open-source data web management tool / portal that provides access to region-related datasets and services, directly fed from GEOSS Platform, and at the same time being the focal node for regional data providers to contribute easily and timely their data to GEOSS. This plays a unique regional role in the promotion of the Data Sharing towards GEOSS and Copernicus implementation, as well as in the direction of the implementation of the SDGs

Impact on **industry**

Low | Medium | High

Impact on **scientists**

Low | Medium | **High**

Impact on **users**

Low | Medium | High

Impact on **policy makers**

Low | Medium | **High**

Timeframe

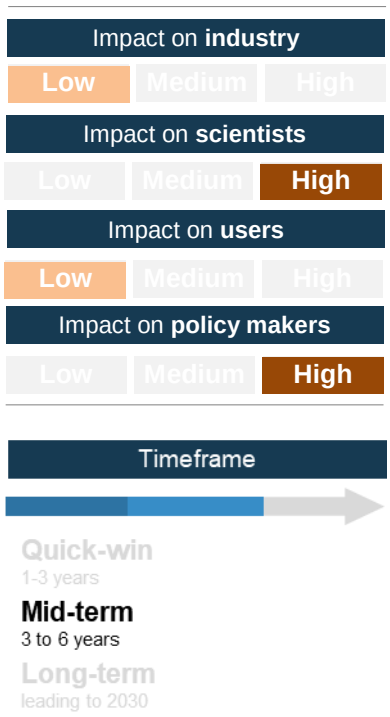
Quick-win
1-3 years
Mid-term
3 to 6 years
Long-term
leading to 2030

Action 3: Improve basic infrastructure, linking with GEANT, etc.

Description

As discussed in 4.1.1, the success of EO activities in the NAMEBA region is often linked to (i) the availability and good operation of basic infrastructure (e.g. internet) and to (ii) the maintenance of existing in-situ networks. In that regard, it is essential that NAMEBA countries receive support and know-how towards the development and maintenance of their infrastructure. **Support provided by GÉANT would be of great use in that regard**, offering the high-bandwidth network that scientists require to make the most of EO data. In addition, actions following on and **scaling up the efforts done under AfriGEOSS, AfricaConnect(2) and other relevant projects should be intensified and tuned towards the needs of the EO community**. In that respect, the participation of entities such as ASREN in GEO should be further leveraged and to the extent possible mirrored in all the sub-parts of NAMEBA. Finally, **infrastructure-based demonstrations** (e.g. in the context of ESA's EO4SD or EO4SDGs projects) or **upcoming results of flagship ICT projects** (e.g. CYBELE under the ICT-11-2018-2019 topic) **should be exploited in this region.**

From a programming point of view, the influence exerted by the joint Africa-EU Strategy should be appropriately channelled in this direction, as should relevant interfaces with ENI and IPA be established.

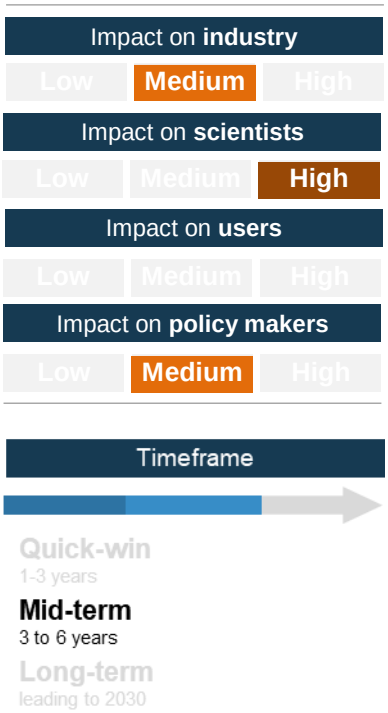


Action 4: Harmonise and integrate regional EO capacities

Description

Building on the proof-of-concept provided within the GEO-CRADLE feasibility studies, and leveraging the outcomes of several key efforts at European level (e.g. TEPs, NextGEOSS, ERAPLANET, the upcoming EuroGEOSS), an organised effort should be undertaken to integrate regional EO capacities. This should take into account the joint regional challenges and user needs in specific sectors of high-priority (e.g. disaster management, water management, energy, agriculture, air quality and dust events, raw materials, etc.). The potential to **create digital innovation hubs** should be explored in line with the efforts of DG CNECT in Europe. Moreover, **data cube solutions** with a regional orientation should be assessed and piloted.

To achieve the above, a **harmonisation of existing data platforms** and gateways should be carried out, defining and promoting the use of the same common standard on the basis of the GEOSS Platform and the DAB API. In time, an **evolution towards knowledge hubs** should be pursued, aided by flagship efforts at GEO level but also through the Copernicus DIAS.



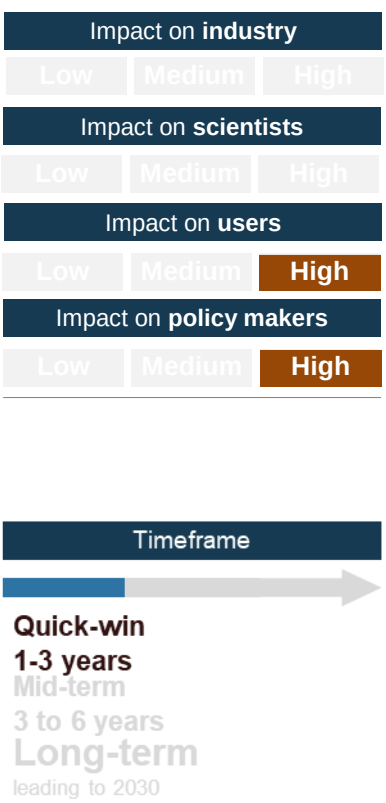
5.2.3 EO in support to policy implementation and decision-making

Action 5: Raise awareness of EO in support of SDG monitoring

Description

The key driver for the sustainable uptake of EO-based solutions and their integration in the SDGs monitoring, evaluation and implementation mechanisms relies first and foremost on the **active and sustained engagement of the local stakeholder ecosystem**. This is especially pertinent to the National Statistics Offices (NSOs) and the relevant line ministries, given their role in this context. In that regard, it is recommended that an orchestrated effort is carried out to raise the awareness of key actors in the NAMEBA region. This should include

1) **The development through the GEO-CRADLE initiative of a Stakeholder Engagement and Capacity-Building Plan**, using the inventory of stakeholders and the current understanding of the project with regards to their maturity levels and their needs. The specifics of this plan should thus be "localised", validated and further enriched with renewed "ground truth" from NAMEBA stakeholders, to ensure that the capacity building activities are appropriately targeted;
2) To develop and implement a **set of high-quality and targeted dissemination and outreach activities** in support of impact maximisation. This includes the generation of promotion materials (incl. building on the work of EO4SDGs and the CEOS Handbook) and a set of well-targeted briefs underlining EO contribution to SDGs generally (mapping against indicators and targets) and at country level;
3) To **provide capacity building** supported by **workshops (or webinars)**, in conjunction with activities undertaken by key players within the GEO-CRADLE network.



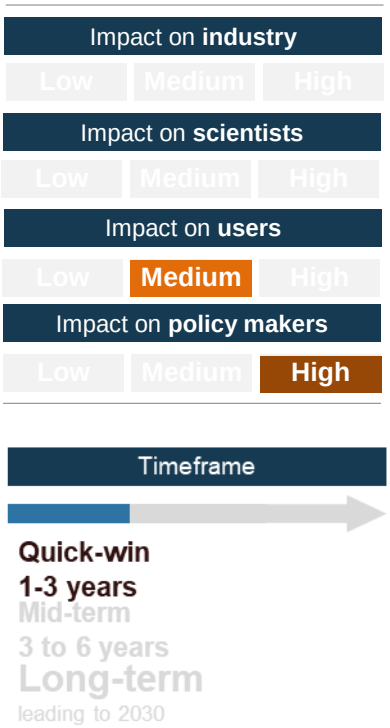
Action 6: Monitor policy priorities at national level

Description

Whether inspired by international treaties (e.g. Paris Climate Change Agreement, Sendai DRR Framework) or driven by national interests and strategies, policy priorities in key sectors such as agriculture, water management, deforestation, public health, etc. are often driving the use of technology enablers such as EO data/services. It is therefore essential to establish a **mechanism monitoring policy priorities**, with the aim to:

- Inform relevant EO stakeholders of opportunities dictated for example by stringent requirements on policy implementation that can be met by using EO solutions
- Promote the use and uptake of EO among policy makers, informing them of the concrete benefits stemming from the use of EO in key sectors.

Such a mechanism could be established in the context of potential upcoming Coordination and Support Actions and/or as part of the mission of GEO offices and relevant structures operating on the ground in the countries of NAMEBA and relaying information between the local ecosystem and international organisations.

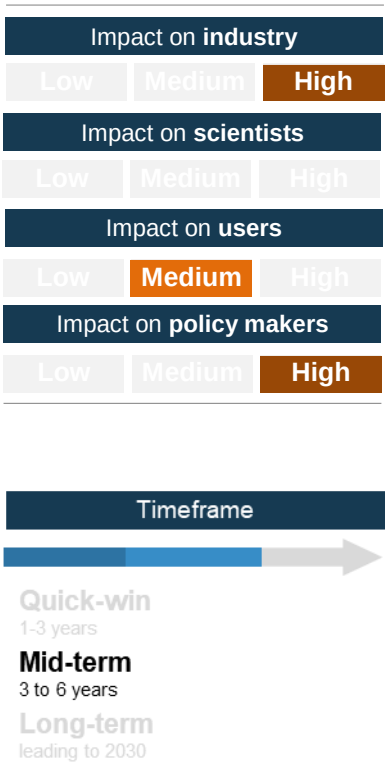


Action 7: Foster operational integration of EO in SDG reporting and monitoring processes

Description

In recent years there has been an orchestrated effort to (i) showcase the value of EO as a tool enabling effective SDG reporting and monitoring, (ii) promote the actual adoption of EO-enabled solutions for the monitoring of specific indicators by the competent authorities at national level. These efforts are spearheaded by initiatives such as GEO's EO4SDGs, the Working Group on Geospatial Information (WGGI) established under Independent Expert Advisory Group for SDGs (IEAG-SDGs), and the UN Committee of Experts on Global Geospatial Information Management (UN-GGIM). In addition, project-based work (e.g. in many H2020-funded projects incl. GEO-CRADLE) has sought to engage local stakeholders or promote EO in a given sector (e.g. food security, water, etc.).

The key action going forward is to **ensure the effective cross-fertilisation of these efforts with a concrete and realistic planning targeting the key stakeholders in the NAMEBA region**. In other words, moving from a fragmented or *ad hoc* basis will require coordination and support actions, sustained pilot activities (turning feasibility studies into long-lasting projects) and – most importantly – championing by countries in the region. As was recently showcased in the context of ESA's call for EO4SDGs projects (with the explicit involvement of Egypt's NSO "CAPMAS" and relevant line ministries) but also with NOA's engagement of the NSO in Greece, there is good momentum in the region. But sustained efforts in that direction as well as scaling up and replication in other countries is the only route to make the impact of such efforts lasting.

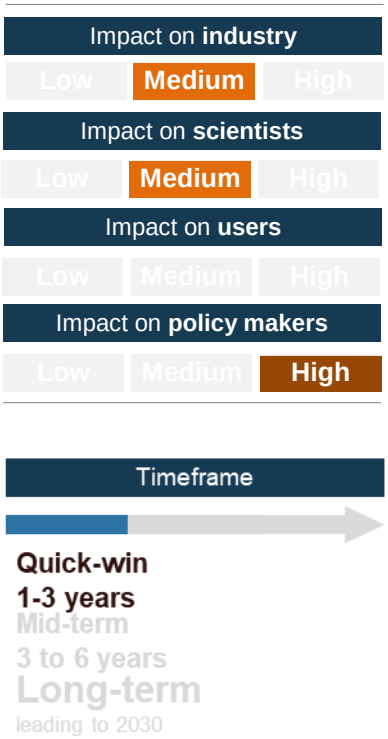


5.2.4 Ecosystem Capacity Building

Action 8: Assess EO maturity at national level

Description

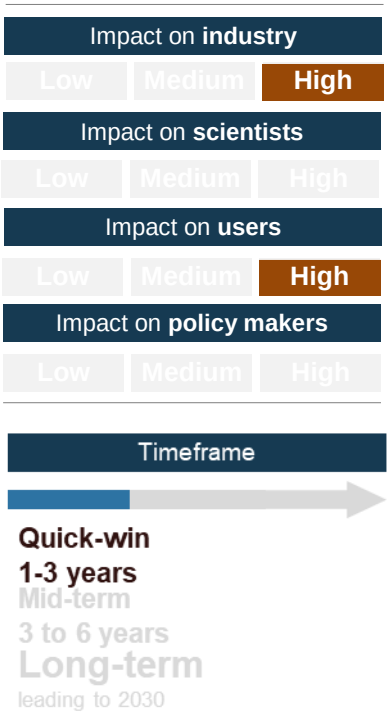
GEO-CRADLE has pioneered the establishment of a novel methodology to assess the state and progress of different aspects of EO activities at national level. The "maturity indicators" methodology has been tested over a period of 15 months, through the mobilisation of the GEO-CRADLE country partners, covering 11 countries from the NAMEBA region. Maturity indicators have been defined, measured and validated across three main fields "Capacities", "Cooperation" and "National Uptake and Awareness", and maturity cards have been produced to allow for a standardised visualisation of the results. The results of the implementation of the methodology in this first phase have been highly appreciated by the GEO Secretariat and by 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 at the national level. Given the keen interest of these key stakeholders, we propose that as part of the GEO-CRADLE Initiative, the methodology will be further implemented, tested and improved in these countries, but also beyond, and a **mechanism for periodic update will be established**. To that effect, the EuroGEOSS initiative will provide a unique opportunity to extend the geographic coverage of this activity. Additional support by and involvement of AfriGEOSS countries and other constituents of GEO, would also be of great importance towards ensuring "independent" implementation. Similarly, **incorporation of EO maturity assessment-related tasks within the scope of GEO offices and/or Copernicus Relays** would be a great way to ensure sustainability and uniformity going forward.



Action 9: Foster "dialogue" between demand and supply through co-design approaches

Description

Involving users in the design of EO services from the very beginning of their development and then iteratively improving the offered solution based on users' specifications is an essential step towards the sustainability of these services. Thus, co-design approaches have been gaining increased attention within the EO sector, as a tool to bridge the demand and supply sides. Nonetheless, more often than not, co-design approaches are simply a new way of labelling user requirements collection and not a fully-fledged, systematically implemented process that is driven by co-design specialists. It is therefore essential, that in the coming years, hands-on expertise in the organization of co-design approaches is combined with EO specialization towards driving the development of EO services across the numerous relevant sectors. To that end, **scaling up and replication of fit-for-purpose procurement processes** – predominantly Pre-Commercial Procurement are highly advised. These could build on the insights and lessons learned from the implementation of the 1st dedicated PCP for EO (Marine-EO), extended and appropriately adopted to the reality of different downstream sectors. Another route towards improved dialogue between demand and supply is opening with initiatives such as INFRAEOSC-01-2018, whereby following extensive user requirements collection processes, **scientific user communities will be able to access EO services in bulk through the European Open Science Cloud**. Linking relevant NAMEBA communities to these activities could be pursued through the GEO-CRADLE Initiative.

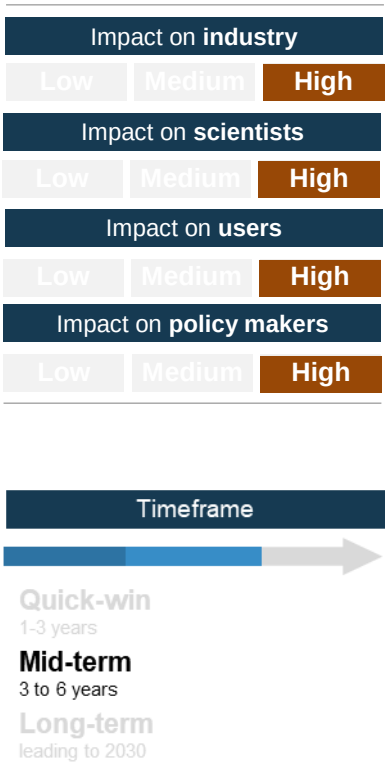


Action 10: Carry out targeted capacity building to "build" EO and sectorial value chains

Description

Each of the links of the EO value chain – as well as the specific value chains in different downstream sectors – require different types of capacity building. Companies, for example, may require training for the effective access and processing of big EO data, the preparation of metadata, the development of solid business plans, the attraction of private capital, the tuning of their services based on user needs, etc. Similarly, scientists with innovative ideas with strong market potential need specialized knowledge towards the establishment of spin-off companies. Users need hands-on training for the integration of EO in their operational workflows. Policy makers may require a better overall awareness of EO benefits in support of decision-making, etc. Pursuing these different streams of capacity building will eventually result in a stronger, value chain appropriately equipped to make the most of the value EO offers. Thus, **sustained efforts supported either by coordination and support actions (for horizontal capacity building) and research and innovation actions (for vertical capacity building) should be systematically pursued**. When considering NAMEBA, different funding avenues should be considered in that direction, including the Copernicus FPA (for EU MS), ESA EO4SD projects, H2020 EO-related projects, GEO flagships and initiatives, and last but not least national programmes.

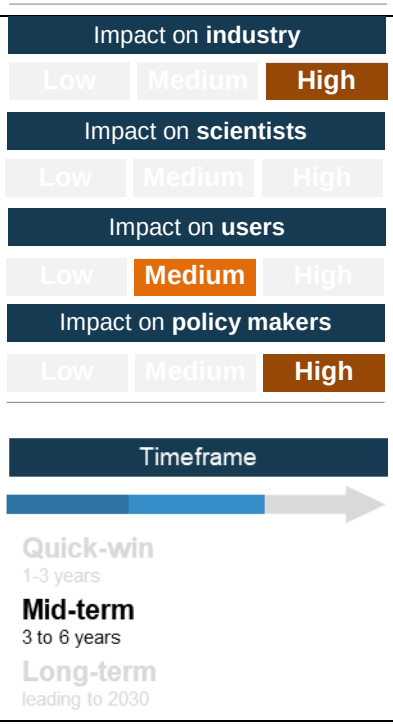
It is important that all these activities not only produce targeted capacity building but also document best practices in appropriate guidelines and make them available on online media (e.g. copernicus.eu, the upcoming knowledge hub of GEO, or future EuroGEOSS-related facilities), so that a greater section of the ecosystem can be reached and benefit from such resources.



Action 11: Scale up EO for Sustainable Development and ODA

Description

As discussed in 4.3.4, EO has strong potential as an enabling tool for Sustainable Development. This is particularly relevant for ODA projects driven by IFIs. Scaling up these activities and linking them with Copernicus (at data, core or downstream service level) and GEO (Flagship and initiative outputs) is particularly relevant for regions such as NAMEBA where sustainable development is typically on top of the political agenda. In practice, we propose that the **results of ESA EO4SD demonstrations in different thematic sectors are followed up on the context of regionally relevant collaborative efforts, e.g. GMES & Africa, AfriGEOSS, GEO-CRADLE Initiative**. The latter can also be strongly leveraged with regards to raising awareness on EO4SD results within the continuously expanding network of EO and non-EO stakeholders in the region.

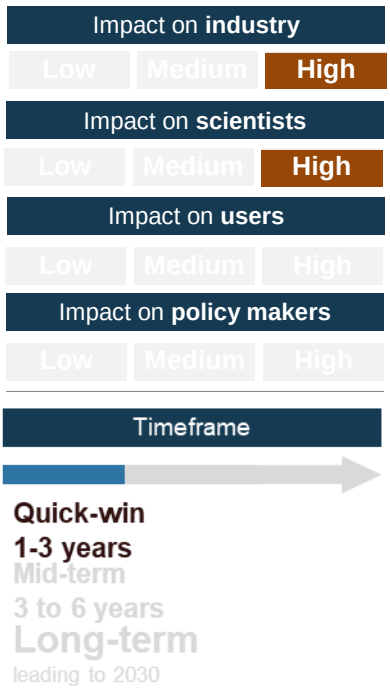


5.2.5 EO Services Sustainability Support

Action 12: Provide systematic support for the exploitation and scaling of R&D results

Description

To systematically support scientists, SMEs, start-ups and even larger companies to progress the operational maturity of their EO services and reach sustainability, a sustained support mechanism needs to be established. This should draw from and promote the various support schemes currently available or under development for the different stages of EO service development: pre-acceleration, acceleration, incubation, market entry, market expansion, etc. In addition, it should ensure robust access to the four key resources that are necessary for EO solution developers to bring their products/services to a higher exploitation readiness level: knowledge, technology, markets, capital. Thus, an **organised support mechanism that provides *inter alia* business/market intelligence, cross-border and cross-sectorial matchmaking, business plan aid, investment readiness assistance, etc. should be set up**. In this process, and as far as NAMEBA is concerned, this resource should take into account the socio-economic reality of the region and the concrete needs and challenged currently faced by the different value chain links.

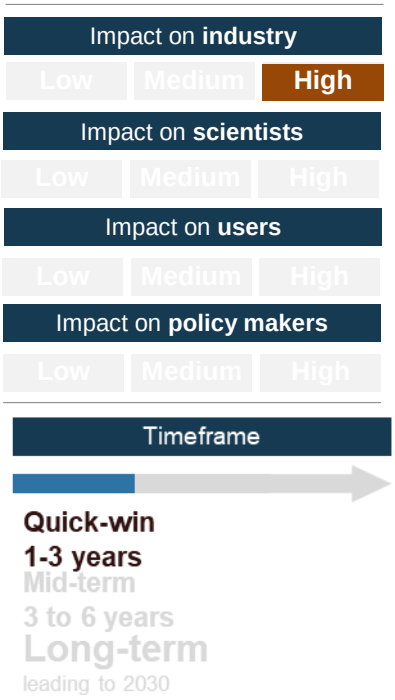


Action 13: Establish internationalisation and export promotion networks

Description

Building on the work done by EARSC in IDEEO and leveraging upcoming opportunities (e.g. "Coordination of European innovators in the domain of Earth observation" under H2020 SC5-16-2019), this action should actualize internationalization and export promotion efforts in the NAMEBA region. To that end, the **establishment of industrial cooperation platforms** and/or associated activities is highly advisable as they can constitute a channel for the monitoring of opportunities in NAMEBA countries and the raising of awareness among the local ecosystems with regards to EO solution capabilities by European companies. In this context, the **collaboration with organisations acting as multipliers** is essential; this concerns for example AARSE – as a bridge between EU and African companies, but also EU clusters with established links or interests in the NAMEBA region (see European Cluster Collaboration Platform). **Trade missions, but also remote networking**, should also be pursued to allow for a structured interaction between the supply and demand side in selected sectors and countries.

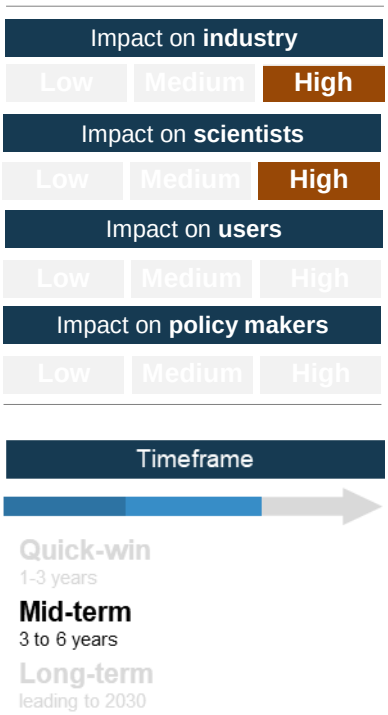
Finally, taking into account the increasingly central role o EO within the digitalisation of many sectors, the internationalisation of EO solutions across the NAMEBA region could benefit from the exploitation of the upcoming eoMALL marketplace.



Action 14: Promote sustainable commercial activities using GEO and Copernicus

Description

GEO-CRADLE, through its feasibility studies, has paved the way for the development and delivery of sustainable commercial activities using GEO and Copernicus. As an example, the development of the Solar Atlas of Egypt which was undertaken under the SENSE pilot, has opened up concrete commercial opportunities in Egypt[8]. Similarly, partnerships built through the GEO-CRADLE network have led to the launch of multiple R&D projects, some of which have a strong commercial orientation (see for instance the Prepare project). Therefore, it is **strongly recommended that the preparatory work of GEO-CRADLE in NAMEBA region is fully exploited within opportunities** such as these enabled by the upcoming H2020 SC5-16-2019 on the "Development of commercial activities and services through the use of GEOSS and Copernicus data".



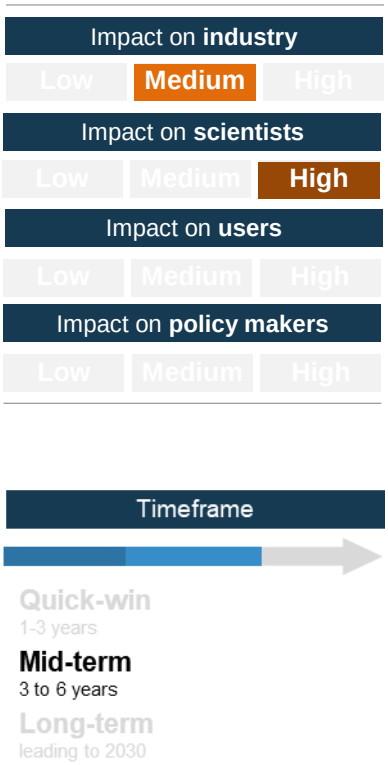
[8] See for example the reference on Horizon Magazine to the elaboration of a business plan for the development of a solar farm powering the New Aswan Heart Centre (work done by Evenflow for the Magdi Yacoub Foundation).

Action 15: Nurture sustainability culture through access to key resources

Description

Copernicus (and previously GMES) has for many years now nurtured the scientific and technological excellence of European actors. Similarly, GEO has provided a platform to extend that at a global level. Through a series of R&D projects (incl. the ones that acted as predecessors to the Copernicus Core Services), European companies, research institutes and governmental organisations have been designing, developing and delivering world-class EO-related data, products and services. In parallel, the GEO Flagships and initiatives have brought forward multi-actor collaboration on the global stage.

Yet, when it comes to operational (i.e. not project or single-contract based) solutions, the market readiness and sustainability potential of several EO solutions is still not fully fledged. This is even more pertinent to the NAMEBA region. For that to be achieved, a **holistic "pipeline" of support from idea to market expansion is required**. Thus, utilising the full portfolio of schemes (Copernicus Accelerator, Copernicus Masters, Copernicus Incubation, or even adjacent programmes such as ESA programmes), **from pre-acceleration and all the way to sustained market presence, a consistent effort to build sustainability-oriented culture should be undertaken**. This could potentially further benefit from a more robust mobilisation of "Copernicus Startup Programme Alumni", i.e. companies that have (gone through the different programmes and) rolled out solutions in NAMEBA, learned the ropes of the market and can share best practices and lessons learned with "Copernicus and GEO Cadets".



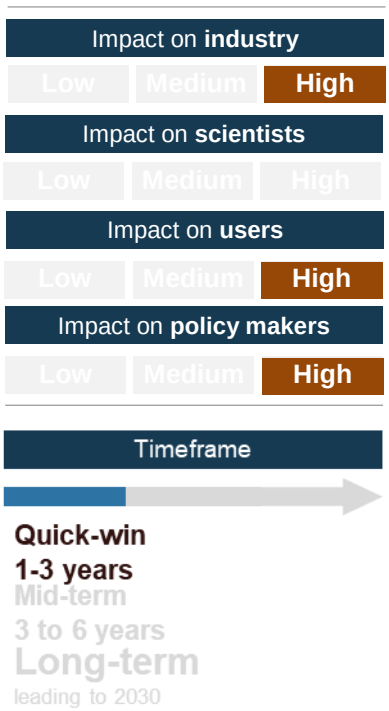
5.2.6 Uptake

Action 16: Identify, communicate and measure EO-based benefits

Description

The effective identification, measurement and communication of EO-based benefits to the multiple downstream stakeholders is not only fundamental for the adoption of EO solutions; it is also essential in terms of assessing the impact of different investments, either in infrastructure (e.g. satellites) or services (e.g. Copernicus Services). Traditionally, this has been pursued with top-down macro-economic studies (e.g. Copernicus Market Report). Yet, in recent years, bottom-up approaches such as these introduced in the Sentinel Economic Benefits Study have gained significant traction. This is thanks to the power of the narrative and the methodological robustness of their implementation. At the same time, several user segments are calling for concrete tools providing cost-benefit analyses at an individual use-case basis (e.g. use of variable rate applications at individual farm level).

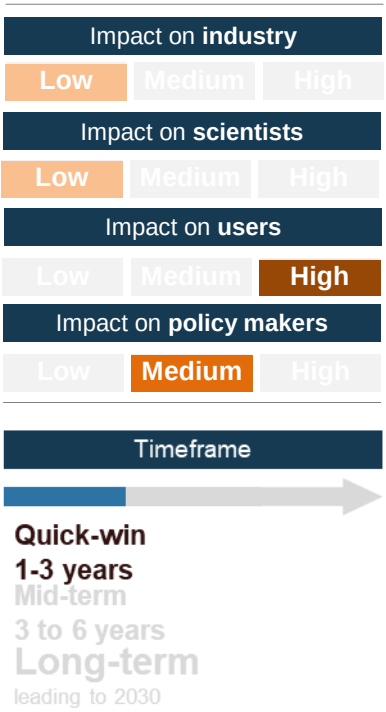
It is therefore important that **the overall uptake of Copernicus and GEO in the NAMEBA region is supported by concrete case studies whereby the socio-economic and environmental benefits from the use of EO data is clearly measured and communicated**. To that end, streamlining and actualising for the region of interest, the efforts mentioned above is recommended. This could be facilitated by international collaboration efforts such as the Geovalue community.



Action 17: Further promote user uptake in sync with Copernicus tools and GEO networks

Description

The first step towards the effective user uptake of Copernicus and GEO in the NAMEBA region, entails the **execution of tailored communication efforts to different groups within the ecosystem**. This can be significantly supported through the targeted use of Copernicus communication and user uptake resources. This includes the **use of Copernicus materials** (brochures, fact sheets, etc.) in the various regional workshops that will be organised by the GEO-CRADLE Initiative; the **exploitation of networking effects through the Copernicus Academies and Relays network**; and the fit-for-purpose **utilisation of training or webinar resources** (by EO4GEO, RUS, or other resources). It also concerns the **exploitation of multiplier effects enabled by the various GEO-related networks** (typically associated with different flagships/initiatives). **Cross-fertilisation with resources developed with EuroGEOSS should also be pursued, especially in connection to best practice guides** that may be developed across different thematic areas or engagement processes (e.g. user requirements collection, capacity building execution, etc.).

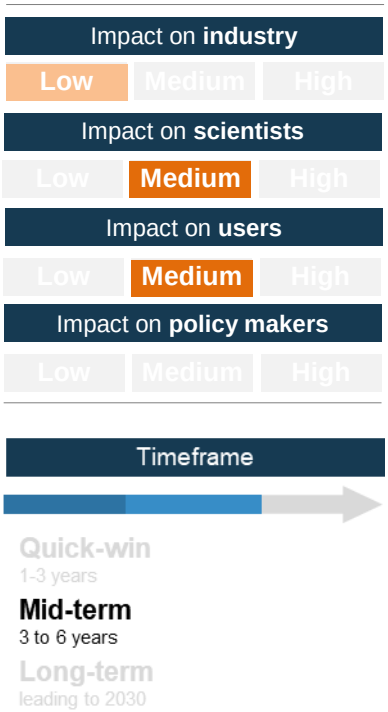


Action 18: Converge GEO Offices and Relays, and scale up networking effects

Description

The effective uptake of GEO and Copernicus in NAMEBA can be substantially supported by the **sustained coordination and engagement of the local ecosystem**. In that regard, it is essential that permanent coordination and/or communication mechanisms are set up or exploited. This can be best achieved by organising a meaningful convergence and cross-fertilisation of the activities of GEO National Focal Points (incl. GEO Offices) with those of Copernicus structures such as the Copernicus Relays and Academies. In this regard, we propose a set of actions including

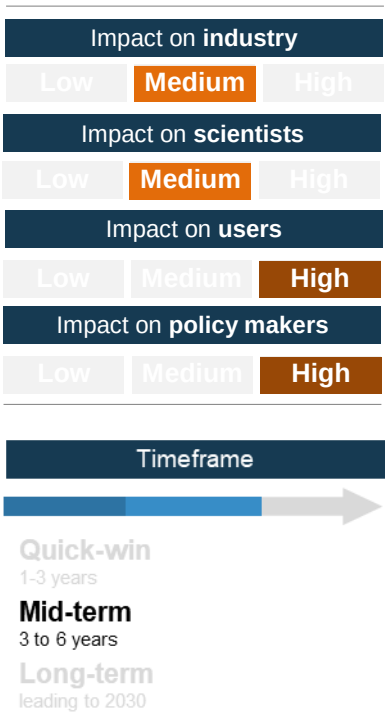
- Triggering and facilitating the **development of GEO National Focal points**, to undertake the coordination of GEOSS activities at the national and regional level. Where possible, these **focal points should establish well-defined channels of communication with their "Copernicus counterparts"**.
- Developing a **collaboration frame between the regional GEO Offices or focal points**, to interface with relevant Regional GEOs (i.e. EuroGEOSS, AfriGEOSS) and promote regional priorities in GEO and EC scheduling of activities.
- Organizing a **sufficient level of dissemination of information via specific channels** (e.g. portal, newsletters) and continuation of **regional workshops** (in collaboration with GEO focal points), to maintain the current momentum. This can be greatly aided by the **sustained operation and scaling – if applicable – of the GEO-CRADLE networking platform**.



Action 19: Promote EO adoption in non-EO programmes (PRIMA, ENI, …)

Description

The uptake of EO solutions in different downstream sectors can be significantly boosted by positioning EO within the planning of non-EO programmes. As an example, the Partnership for Research and Innovation in the Mediterranean Area, which focusses on the development and application of solutions for food systems and water resources in the Mediterranean basin, can greatly benefit from relevant EO solutions. It is therefore a prime case where a **systematic engagement of the stakeholders who influence the scope of the programme is called for and would be mutually beneficial**. For such systematic engagement to be achieved, a combination of nationally and regionally driven efforts is necessary. Thus, led by key organisations – typically actively involved in the GEO-CRADLE network – national policy and decision makers should be regularly engaged in awareness raising and capacity building activities. Similarly, international bodies should be engaged to provide them with regional "ground truth". For the latter to be achieved, **the GEO-CRADLE initiative might be best positioned to aggregate the voices of the different parts of the regional ecosystem and relay them to actors with an appropriate leverage for engaging PRIMA, ENI,** etc (i.e. DG GROW, DG RTD, GEO).

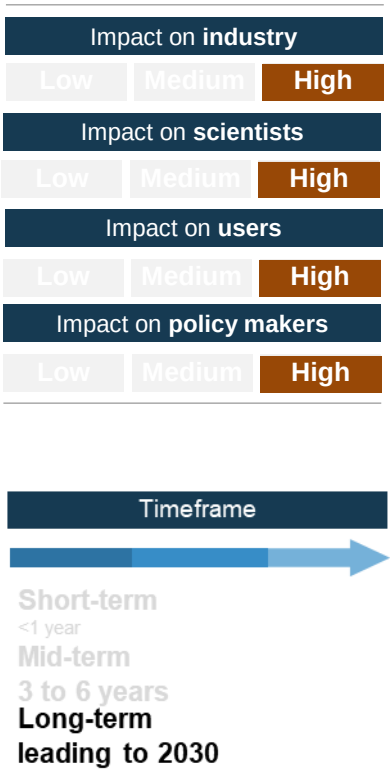


Action 20: Develop and implement a Strategic Research and Innovation Agenda, informed by regional priorities and leveraging investments

Description

The various recommended actions put forward in this roadmap are shaping a vision for the streamlined implementation of GEO/GEOSS and Copernicus in the NAMEBA region, with the ultimate aim to promote the uptake of EO solutions in support to regional challenges. The realization of this vision as a whole – but also of many of the objectives tied to the individual actions proposed here – relies on multi-stakeholder cooperation, cross-sectorial coordination of activities and smart utilization of investments. In this regard, **meeting the commonly-shared high-level objectives served by the proposed actions (presented in chapter 4), would greatly benefit from the elaboration of a Strategic Research and Innovation Agenda (SRIA)**. SRIAs are the guiding document of many sectors with significant economic output, strong potential to address societal challenges and reliance on Public-Private collaboration to realise this potential.

In the case of NAMEBA, all these criteria are certainly fulfilled (as substantiated in the previous chapters). It is therefore highly advisable that the implementation of the actions put forward herein is guided by such a SRIA. **Its development should use this roadmap as the basis and expand to cover horizontal (i.e. cross-cutting) or vertical (i.e. sector-related) aspects as needed**. This should be supported by a Coordination and Support Action – not necessarily geographically confined to NAMEBA but certainly placing adequate weight to it.



6 Way forward

In this report, we have attempted to draw a thorough picture of the current state-of-play for EO activities in the NAMEBA region and to propose concrete actions towards shaping an ambitious yet realistic future. In that respect, we hope that this roadmap will set the wheels in motion, for the improved implementation of GEO/GEOSS and Copernicus in the NAMEBA region. Ultimately, this will rely on the sustained collaboration among the EO actors in the region. This will be supported by GEO-CRADLE in its new form as a GEO Initiative. In that regard, we will strive to exploit all possible avenues (in terms of funding schemes or support mechanisms) to realise a future vision in NAMEBA, whereby the impact of EO on informed decision-making will be maximised.

7 Annex 1

GEO-CRADLE has successfully organised a series of regional workshops (12), dedicated side events (3) and national networking activities (2).

GEO-CRADLE Regional Workshops		
Date	Location	Photo
14/7/2016	Novisad, Serbia	
17-18/10/2016	Rabat, Morocco	
19/10/2016	Timimoun, Algeria	
16-17/11/2016	Limassol, Cyprus	
3/1/2017	Chişinău, Moldova	
2/2/2017	Abu Dhabi, United Arab Emirates	
24/3/2017	Sofia, Bulgaria	
9/5/2017	Bucharest, Romania	

25/5/2017	Cairo, Egypt	
14/9/2017	Tel Aviv, Israel	
7/12/2017	Tunis, Tunisia	
15-16/3/2018	Istanbul, Turkey	
4-5/6/2018	Thessaloniki, Greece (3rd South-Eastern Europe GEO Workshop)	
Dedicated Side Events organised by GEO-CRADLE		
Date	Location	
26/4/2017	Brussels, Belgium (Improving EO services industry involvement in EU space programmes and initiatives)	
19-21/6/2017	Helsinki, Finland (11th GEO European Projects Workshop)	
29/10-3/11/2018	Kyoto, Japan (GEO WEEK 2018)	
National Networking Activities by GEO-CRADLE partners		
Date	Location	
27/4/2016	Cairo, Egypt	

26/9/2016	Tirana, Albania	

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