

HEADING 1A: Competitiveness for growth and jobs**European Earth Observation Programme (Copernicus)****Lead DG: DEFIS****I. Overview*****What the programme is about?***

Copernicus is the European system for monitoring the Earth. It is a user-driven programme offering six free-of charge services to EU, national, and regional institutions, as well as to the private sector: atmosphere monitoring, marine environment monitoring, land monitoring, climate change, emergency management and security. The programme builds on the initiative on global monitoring for environment and security launched in 1998. It aims at filling the gaps in European earth observation capacities. Data is provided from space infrastructures, particularly the sentinel missions developed under the programme, other missions and in-situ infrastructure supported by the Member States. Copernicus services are mainly operated by European Union bodies and agencies.

The Copernicus Services transform this wealth of satellite and in situ data into value-added information by processing and analysing the data. Datasets stretching back for years and decades are made comparable and searchable, thus ensuring the monitoring of changes and their impact; patterns are examined and used to create better forecasts, for example, of the ocean and the atmosphere. Maps are created from imagery, features and anomalies are identified and statistical information is extracted.

EU added value of the programme

Copernicus is a programme originally launched under the Europe 2020 strategy for smart, sustainable and inclusive growth, and is actually a component of the new Space Regulation, based on the European Space Strategy. Given its benefits to a wide range of EU policies and its potential for reaching the objectives of the European Green Deal, Copernicus is a prominent industrial as well as environmental policy programme. Copernicus delivers useful data and information for EU policies for agriculture, environment, development and humanitarian aid, energy or coastal surveillance, smart cities, climate change adaptation, transport, border security and many other fields, including the IT sector, culture, and education.

The Copernicus programme cannot be realised by a single Member State alone because it encompasses a pan-European capacity and depends on the provision of data and services throughout all the Member States, which needs to be coordinated at Union level. Therefore, by reason of the scale of the action, the programme is better achieved at Union level, and may adopt measures, in accordance with the principle of subsidiarity as set out in Article 5 of the Treaty on European Union.

Implementation mode

Copernicus has a financial envelope of EUR 4.3 billion for 2014-2020. The first part of the budget (EUR 3.394 billion) is dedicated to the development of the capacity, managed under indirect management through delegation agreements signed in 2014 with ESA and EUMETSAT.

The second part of the budget (EUR 0.897 billion) concerns the Copernicus Services, implemented both under indirect and direct management. For the indirect management part, there are in total six delegation agreements with entrusted entities, providing six services. Three delegation agreements with the European Environment Agency (EEA), the European Medium-Range Weather Forecasting Centre (ECMWF) and Mercator-Océan have been signed in 2014. Two more with EU Agencies FRONTEx and EMSA were signed by the end of 2015; and the final delegation agreement with EUSatCen was signed in 2016.

The remaining part of the budget is dedicated to actions under direct management, mostly those supported by the JRC in order to implement the Copernicus Global Land and Emergency services, and the user uptake activities.

II. Programme Implementation Update***Implementation status (2017-2019)***

During 2017 major progress has been made with the launch of Sentinel 2-B on 6 March, and of Sentinel 5p on 13 October. The addition of Sentinel-5p is of particular significance, as it adds the Copernicus own capacity to monitor atmospheric composition, especially as regards important polluting gases.

On 25 April 2018 Sentinel 3-B was launched. The 7 satellites are in orbit and operational as planned. Moreover, the six Copernicus Services are operational. In response to a great surge in users' uptake being registered, bringing the number of registered users to more than 200 000, 5 new Data and Information Access Services (DIAS) platforms have been launched and are operational since June 2018. More cooperation agreements have been signed with third countries and associations, including the African Union, Ukraine, Serbia, Chile, Brazil, Colombia, and India. The Commission was also Chair of the Committee on Earth Observation Satellites (CEOS) for 2018.

In 2019 all the set priorities have been reached. Preparations for the 8th satellite, result of an international cooperation, Sentinel 6A, have been completed. Construction and preparations for launches and operations of the first Sentinel C and D Units have proceeded

as planned. All six core services continue to be fully operational. The dissemination of Copernicus data and information having been strengthened, the user base reached new records. International activities have been pursued with old and new agreements, to promote the uptake of Copernicus data globally in order to maximise its societal value in addressing global challenges; to create the conditions – on the basis of reciprocity – for integrating the data and information acquired by international partners into the European Earth Observation data management system; and to facilitate international cooperation and access to international markets for European researchers and industry. As of December 2018, the European Commission had signed Copernicus Cooperation Arrangements with the following administrations: (i) Americas: United States, Brazil, Chile, and Colombia; (ii) Africa African Union Commission; (iii) Asia: India; (iv) Oceania: Australia; (v) Europe (candidate and associated countries): Serbia, Ukraine. In 2019, discussions have been launched or continued for cooperation arrangements with Argentina, the United Nations Environment Programme (UNEP), the Food and Agriculture Organisation (FAO), the World Meteorological Organisation (WMO); Canada, Vietnam, Thailand, Panama and the Holy See; the Indonesian Space Agency, the Ministry of Economy, Trade and Industry of Japan.

This completes the first phase of the strategy with regard to Copernicus Cooperation Arrangements. As a result, Copernicus' free, full and open data access is expected to reach ca. 50 % of the world's population via a local data hub.

The main issue for the future will be the continuity of the operation, given that new satellites will have to be launched, in replacement of the actual in-orbit operating ones, when these will have completed their end-of-life cycle; Services might also need to expand towards new areas, in response to user requirements, in sectors as agriculture, coastal areas development, polar areas monitoring, CO₂ anthropogenic emissions control.

Key achievements

The seven Copernicus satellites now in orbit are producing high quality, free, and open observation data every day reaching more than 300 000 registered users. More than 12 million data products are published and the users' download volume has reached more than 200 million Gigabytes.

Copernicus Emergency Management Service (CEMS): the CEMS Rapid Mapping component was activated over 81 times in 2019 to cover, among others, forest fires in Greece and Italy and wildfires in Australia.

Copernicus Marine Environment Monitoring Service (CMEMS): A new release of the product portfolio was issued with improvements to ocean monitoring. The Copernicus Ocean State Report #3 was published, highlighting changes in the marine environment due to climate change up to year 2017, and providing an important contribution to the Sustainable Development Goal 14 (SDG 14 – ocean acidification). The number of registered users accessing the service continues to grow and has now reached nearly 20 000.

Copernicus Land Monitoring Service (CLMS): In 2019, the service provided the finalised products for land cover and land use at pan-European level and the complementary high-resolution layers on specific land cover characteristics for the reference year 2015. It also started the processing of the High resolution products for the 2018 reference year, and the preparation for next generation Corine Land Cover product (CLC+) that will support the LULUCF (Land Use, Land-Use Change and Forestry) reporting obligations, coastal zone monitoring information in preparation with the CMEMS and High Resolution Vegetation Phenology. At Global level, in 2019 the service produced yearly mid-resolution land cover maps of the Earth's surface. The service delivered also on a ten daily basis over 20 variables supporting the monitoring of vegetation, agriculture, energy, cryosphere and water cycle.

Copernicus Atmosphere Monitoring Service (CAMS): In 2019, the joint work between CAMS and Sentinel 5P observations providers has allowed substantial progress to bring the different Sentinel data products to the high level of quality required for active assimilation in the CAMS global operational system. The CAMS success stories are showcased on the CAMS website ⁽¹⁾. Euronews continued to air daily air quality bulletins over Europe based on CAMS. A survey has estimated that, in the period June to September 2019, these bulletins have been seen by more than 7 million people across all platforms. In parallel, a media partnership with CNN International began in July 2019 to broadcast air quality updates (and climate updates) across the CNN global TV network.. CAMS has also continued to be the primary source of information for leading smartphone applications about air pollution: Apple/The Weather Channel, Windy, Breezometer, Plume Labs... Finally, all this resulted into a very substantial impact and visibility of CAMS in the international press and online media on topics such as wildfires, air quality or the ozone hole.

Copernicus Climate Change Service (C3S): The service entered its operational phase in June 2018 and has now a user base of over 30,000 registered users. At the end of 2019, 308 entities from 29 countries and international organizations are contributing to this European effort. Data released by the Copernicus Climate Change Service (C3S) show that 2019 was the second warmest year in a series of exceptionally warm years across the globe, as CO₂ concentrations continue to rise. Many sectoral applications are benefitting from the Service including agriculture, forestry, health, energy provision, water management, tourism and biodiversity. C3S delivers immense amount of climate data and information – over 16000 TB of total data delivered- and C3S is heavily invested in quality-assurance activities that cut across the datasets, tools, applications and services. C3S publishes monthly climate bulletins, the annual European State of the Climate and key indicators of climate change.

Copernicus Security Service (CSS): The **Copernicus Border Surveillance service (CBS)** in 2019 added three new services. In the first half of 2019, Copernicus/Eurosur Fusion Services supported Europol-led law-enforcement operation Tayrona, in which

⁽¹⁾ <https://atmosphere.copernicus.eu/>

FRONTEX provided resources to protect EU external borders, focusing on countering drug smuggling and firearm trafficking in the Atlantic. In addition, Earth Observation tools have contributed to increase the efficiency of Frontex surveillance operations, where several thousand irregular migrants were detected at EU external borders. **Copernicus Maritime Surveillance service (CMS):** By the end of 2019, there were 42 user organisations registered in the system, which represents a 45 % growth in number of organisations compared to the previous year. Furthermore, a total of 3,972 EO services (i.e. one satellite image product and any relevant additional data) were delivered during the year, all at the direct request of users. CMS provided crucial support to fisheries control operations and assisted the United Nations Office of Drugs and Crime (UNODC) for several operations in Western and Eastern Africa and Sri Lanka. At the request of the Danish Defence Command – Joint Arctic Command (JACO), CMS continued to monitor pollution in Greenland on a regular basis. CMS also continued supporting customs authorities, contributing to successful operations resulting in the apprehension of drug traffickers, and supporting law enforcement operations, such as the EUNVAFOR Atlanta and Sophia operations, and Member State law enforcement authorities. **Copernicus Service in Support to EU External Action (SEA):** In 2019, the overall number of requests more than doubled, with a total of 148 requests received – a 35 % production increase compared to 2018. The number of users accessing the service also considerably increased – around 60 % – compared to 2018.

The data and information access service (DIAS) allowed better Copernicus data and information uptake. The user base has dramatically increased to above 300 000 users and is still growing. Copernicus relies not only on satellites data, but also on a wide range and number of in-situ data. This component established in 2017 an agreement with EUMETNET encompassing all six Copernicus services – it is foreseen to have a single interface providing access to meteorological, hydrological, and climatological data owned by all EUMETNET members which is recognized as a best practice of efficiency.

User uptake activities maximising the use of Copernicus applications by public and private users have been extended. A Framework Partnership Agreement with the Member States (plus Iceland and Norway) has been opened since 2017. A Copernicus support office (which acts as a helpdesk), two networks of local multipliers (the Copernicus Relays and Academy) have been set up and a communication campaign including video materials, factsheets, brochures, online tutorials, an online exchange platform and workshops has been developed. To support young companies, Copernicus Masters, Hackathons, Incubation and Accelerator Programme and training courses and material have added considerable support to universities and research, through the Copernicus Skills programme. An ERASMUS+ sectoral skill alliance for Earth Observation was created, with multiple universities and research centres developed curriculum material based on Copernicus. A summer course on Copernicus was organised with KIC Climate Change, while the Commission continues to finance post-doc scholarships in partnership with the KIC raw material. The Copernicus ‘Research and User Support’ service portal provides online training and technical support to users throughout Europe. Finally, in 2019 in Horizon 2020, 5 topics on Copernicus and 11 projects related to the programme were launched,

Cooperation arrangements have been concluded with the United States, Australia, Brazil, Chile, Colombia, the African Union Commission, India, Serbia and Ukraine. Negotiations are ongoing with Argentina, Indonesia and with the United Nations Environment programme (UNEP). With Japan, New Zealand, Singapore, Thailand, Vietnam, as well as the Food and Agriculture Organisation (FAO) and the World Meteorology Organisation (WMO) initial discussions are starting. Two workshops were organised for Ukraine and ASEAN countries promoting Copernicus.

In 2018, the European Commission took over the chair of the Committee for Earth Observation Satellites (CEOS) and is now recognised as a major space player and Copernicus is regarded as the global benchmark for earth observation. The UNFCCC COP25 conference acknowledged the increasing relevance of systematic atmospheric observations and modelling such as provided by Copernicus. This applies specifically to the implementation of the Paris Agreement, but as well to other policies of international or global nature, such as the UN 2030 Agenda for Sustainable Development, and the European Development Policy. Other collaborations with main global stakeholders are currently being established including with the Integrated Global Greenhouse Gas Information System (IG3IS) of the World Meteorological Organization (WMO).

Evaluation/studies conducted

The key findings of the Impact Assessment accompanying the Proposal for a Regulation of the European Parliament and of the Council **establishing the space programme of the Union and the European Union Agency for Space Programme** ⁽²⁾, and of the study on **ex-ante evaluation of the socioeconomic benefits of Copernicus** ⁽³⁾ have been presented in the Programme Statement 2019.. Key challenges for the future relate to global and political developments (such as climate change, security, competitiveness of European industry) as well as to lessons learned from the implementation of the programme in the past (such as governance, data distribution and linking space data with other policy areas). The priorities are (1) continuity of services (2) new missions and evolution of services, (3) development of new activities in support of answers to societal challenges, for example help in implementation of the European Green Deal. The governance model proposed for the next financial period builds on the current framework, whilst taking advantage, where appropriate, of synergies, notably as regards security.

The **Copernicus market report 2019** ⁽⁴⁾ looked at the current uptake of Copernicus in Europe. The second edition of the Copernicus Market Report details how Copernicus free and open data and information is used to tackle more and more societal,

⁽²⁾ SWD(2018) 327 final

⁽³⁾ <https://www.copernicus.eu/en/study-estimates-copernicus-benefits-be-10-times-its-costs>

⁽⁴⁾ https://www.copernicus.eu/sites/default/files/PwC_Copernicus_Market_Report_2019.pdf

environmental and economic challenges – ranging from floods and wildfires to insect infestation and forest regrowth. The report was commissioned by the European Commission and is an update to the previous Market Report from 2016. It contains numerous new analyses, comparisons and deep dives into new benefit areas. With over 200,000 users, Copernicus is expanding fast. It has doubled its footprint on the Earth Observation (EO) scene and now supplies 20 % of the world’s EO data. The volume of downloads grew by 133 % since the first Market Report was released in 2016. On top of that, the report found that 72 % of EO companies in Europe use Copernicus (+ 11 percentage points since 2016). In a single year (2018), Copernicus generated EUR 2.9 billion of benefits to its European users, nearly half the cost of the programme. Copernicus represented about 20 % of the data used in Earth observation applications. The market for Copernicus-based applications is growing at 15 % per year.

Forthcoming implementation

For 2020, a further Sentinel launch (Sentinel 6A) is foreseen bringing the number of operational satellites to 8, as planned. The main objective of Sentinel 6 is to provide high-precision measurement of the sea level, with evident relevance for climate change observations. On the data dissemination side, the start of operations of the data and information access service has marked improved access to Copernicus, and add processing capabilities in a cloud environment for the users. New products are being tested for use, for example the ground motion service, and new non-space specialists user communities are being targeted for uptaking campaigns, for example farmers and cultural heritage operators.

Outlook for the 2021-2027 period

For the next long-term EU budget 2021-2027, the Commission proposed the budget to help maintain and further enhance the EU’s leadership in space. The Commission’s proposal brings all existing and new space activities under the umbrella of a single EU space programme. The proposal for the EU space programme maintains existing infrastructure and services and introduces a number of new features such as fostering a strong and innovative space industry in Europe, maintaining Europe’s autonomous access to space and a unified system of governance. For Copernicus in particular, its contribution to the European Green Deal, will be highlighted by a new CO2 anthropogenic emissions control mission, to verify the Paris agreement commitments. Among other missions in the pipeline, a polar mission to observe Arctic changes and a land surface temperature monitoring mission.

III. Programme key facts and performance framework

1. Financial programming

Legal Basis	Period of application	Reference Amount (EUR million)
Regulation (EU) No 377/2014 of the European Parliament and of the Council of 3 April 2014 establishing the Copernicus Programme and repealing Regulation (EU) No 911/2010	2014 – 2020	4 291,5

	Financial Programming (EUR million)							
	2014	2015	2016	2017	2018	2019	2020	Total Programme
Administrative support	2,5	2,5	2,6	2,6	2,6	2,9	3,0	18,7
Operational appropriations	360,4	553,9	583,6	604,8	627,6	858,6	643,9	4 232,8
Total	362,9	556,4	586,2	607,4	630,2	861,5	646,9	4 251,5

2. Implementation rates

	2019				2020			
	CA	Impl. Rate	PA	Impl. Rate	CA	Impl. Rate	PA	Impl. Rate
Voted appropriations	861,470	100,00 %	603,078	99,65 %	646,947	93,38 %	552,000	23,80 %
Authorised appropriations (*)	881,998	100,00 %	619,229	99,64 %	662,561	93,09 %	567,437	25,18 %

(*) Authorised appropriations include voted appropriations, appropriations originating from assigned revenues (internal and external) as well as carried-over and reconstituted appropriations; the execution rate is calculated on 15 April 2020

3. Performance information

Programme performance

The programme has continued to meet the criteria established in its general and specific objectives. The monitoring capacities, intended as operating satellites in orbit, ground infrastructure and in-situ network, have been successfully deployed. This has guaranteed the achievement of an European autonomous access to environmental knowledge and a major role of the EU at international level. The six core services are all operative and provide the expected accurate and reliable level of geo-information. The quality of the outputs is confirmed by the consistent growing level of registered users up taking the programme products and information to face this surge distribution, capabilities have been enlarged through the above mentioned DIAS service. To further facilitate the uptake it might be useful to plan a ‘cloudification’ of data, enabling also the European digital Big Data projects implementation. The socioeconomic benefits have been consistently monitored and measured: the last Copernicus market report

published in February 2019 (referred to ten selected value chains) claims that the benefits in 2018 in the downstream market are estimated to be between EUR 125 and 150 million, up from EUR 54 million in 2015. They are expected to grow by an average annual growth rate of 15 % up to the end of 2020, with a progressive adoption of EO-based solutions in some industries such as renewable energies.

The downstream Earth observation (EO) sector includes all enterprises whose main business is to provide services based on EO data. The Copernicus Market Report 2019 also confirmed that 72 % of these companies use Copernicus data (an additional 6 percentage points compared to 2016). The European downstream EO sector had 6 000 full-time jobs in 2012 and 7 877 in 2016. The average growth rate of 10 % (observed between 2012 and 2016) was applied to produce estimates for 2017 and 2018.

The objective to foster the development of a competitive European space and services industry and maximising opportunities for European enterprises to develop and provide innovative Earth observation systems and services has shown positive results. The original baseline scenario assumed a 5 % annual growth rate between 2013 and 2020 in the European EO sector, thanks to the availability of Copernicus data and services. Instead, the annual growth rate observed during 2016 – 2018 period has been 14 %, demonstrating a positive effect of Copernicus ⁽⁵⁾.

The international dimension has been enlarged through specific agreements signed with several countries, adding to the role of the EU in international fora and conferences, including various UN agencies. With the conventional data access infrastructure (e.g. ESA Open hub) and the setting up of the Copernicus Data and Information Access Services (DIAS), the entire Copernicus database is available on a free, full and open data policy, including to GEOSS members. The target of 100 % excludes the restricted products from the Emergency and Security Services.

General objectives

General Objective 1: Monitoring the Earth to support the protection of the environment and the efforts of civil protection and civil security

Indicator 1: Number of specific service components corresponding to users’ service-level requirements to realise that Copernicus data and Copernicus information is made available for the environment, civil protection and civil security

Baseline	2014	2015	2016	2017	2018	2019	2020	Target
2013	Milestones foreseen							2020
Service components put into operations during year:	0	6	5	2		1	0	0
	Actual results							
	2	2	6	3	1			
2013	Milestones foreseen							2020
Total number of Operational service components: 6	0	6	11	13	13	14	14	14
	Actual results							
	2	4	10	13	14			

Comment: Service components operational at end of 2018 are Emergency Mapping, Early Warning System of Floods, Early Warning System of Forest Fires, Pan-EU land service, EU local Land service, Global land service including Global hot spot service, Atmosphere and Marine services, the three security service components (border surveillance, maritime surveillance, support to external action) and provision of access to reference data access = responding to Copernicus Regulation Art 5(1). The Climate Change Service is operational since June 2018 (earlier than the milestone initial plan which was set in 2019). The milestone was initially foreseen in 2019 and the actual result was advanced to 2018.

General Objective 2: Maximising socioeconomic benefits, thus supporting of the Europe 2020 strategy and its objectives of smart, sustainable and inclusive growth by promoting the use of Earth observation in applications and services

Indicator 1: Expected growth in downstream Earth Observation sector directly benefiting from Copernicus

Baseline	2014	2015	2016	2017	2018	2019	2020	Target
2012	Milestones foreseen							2020
				140			180	180
	Actual results							
			131	144	159			

⁽⁵⁾ https://www.copernicus.eu/sites/default/files/PwC_Copernicus_Market_Report_2019.pdf

Methodology: baseline index = 99

Comment: The growth of downstream EO sector is measured in terms of employment figures on the sector, with baseline as measured in 2012. The downstream Earth observation (EO) sector includes all enterprises whose main business is to provide services based on EO data. The Copernicus Market Report 2019 confirmed that 72 % of these companies use Copernicus data (an additional 6 percentage points compared to 2016). The European downstream EO sector had 6 000 full-time jobs in 2012 and 7 877 in 2016. The average growth rate of 10 % (observed between 2012 and 2016) was applied to produce estimates for 2017 and 2018.

Unit of measure: Employment index

General Objective 3: Fostering the development of a competitive European space and services industry and maximising opportunities for European enterprises to develop and provide innovative Earth observation systems and services

Indicator 1: Market penetration, including expansion of the existing markets and creation of new markets and competitiveness of the European downstream operators

Baseline	2014	2015	2016	2017	2018	2019	2020	Target
2013	Milestones foreseen							2020
100		105		116		128	140	140
	Actual results							
			149	170	195			

Methodology: baseline index = 100

Comment: The original baseline scenario assumed a 5 % annual growth rate between 2013 and 2020 in the European EO sector, thanks to the availability of Copernicus data and services. Instead, the annual growth rate observed during 2016 – 2018 period has been 14 %, demonstrating a positive effect of Copernicus.

General Objective 4: Ensuring autonomous access to environmental knowledge and key technologies for Earth observation and geoinformation services, thereby enabling Europe with independent decision-making and action

Indicator 1: Number of directives and decisions directly invoking the use of Copernicus data and Copernicus information by Union institutions and bodies for autonomous decision-making

Baseline	2014	2015	2016	2017	2018	2019	2020	Target
2013	Milestones foreseen							2020
5				15			12	12
	Actual results							
			7	8	10			

Comment: Official legislative acts directly referred to the Copernicus programme:

Directives and decisions mentioning the use of Copernicus

CELEX number Publication Reference

32014D0261 OJ L 136, 09/05/2014, p. 35

32013D1313 OJ L 347, 20/12/2013, p. 924

32013D1386 OJ L 354, 28/12/2013, p. 171

32017Y0322 OJ C 89, 22/03/2017, p. 1

32016Y1001 OJ C 363, 01/10/2016, p. 1

32013R0100 OJ L 81, 21/03/2012, p. 7

32011R1255 OJ L 321, 5.12.2011, p. 1

32006R1974 OJ L 368, 23.12.2006, p. 15

32018D0621 OJ L 51, 23.2.2018, p. 17–22

32018D0620 OJ L 102, 23.4.2018, p. 23–55

The table above refers to the five directives/legislative acts published before 2014 (referring to GMES- the former name of the Copernicus programme) and the new acts since 2014. It does not refer to other DGs directives or regulations, involving the use of Copernicus (e.g.: environmental legislation, Climate Action, Maritime Affairs, Agriculture and Rural Development etc.)

General Objective 5: Supporting and contributing to European policies and fostering global initiatives, such as GEOSS

Indicator 1: Percentage of Copernicus global Earth Observation data available through Global Earth Observation System of Systems (GEOSS)

Baseline	2014	2015	2016	2017	2018	2019	2020	Target
2013	Milestones foreseen							2020
0 %	approximately 10 %	20 %	40 %		75 %		100 %	100 %
	Actual results							

				40 %	100 %			
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Comment: With the conventional data access infrastructure (e.g. ESA Open hub) and the setting up of the Copernicus Data and Information Access Services (DIAS), the entire Copernicus database is available on a free, full and open data policy, including to GEOSS members. The target of 100 % excludes the restricted products from the Emergency and Security Services. The data for this indicator is from the yearly report provided by the European Environment Agency (EEA), the European Centre for Medium-range Weather Forecasts (ECMWF), Mercator Ocean, Frontex and the European Maritime Safety Agency (EMSA).

Specific objectives

Specific Objective 1: Delivering accurate and reliable data and information to Copernicus users, supplied on a long term and sustainable basis enabling the services referred to in Article 4(1) and responding to the requirements of Copernicus Core Users

Performance

As regards the specific objectives the achievements have been confirmed for the accuracy and reliability of data provision, the in-situ component and the users’ number. The high level of uptakes is actually a result of the quality of the services provided. The number of registered users showed a steady increase and almost the doubling of engaged users. At the end of 2019, there were more than 300 000 users registered, demonstrating a steady increase in the number of users. About 20 % of the registered users are active ‘satisfied’ users (downloading a product at least once in the last quarter). The number of active users has been growing as quickly as the number of registered user, keeping the ratio stable.

Indicator 1: Number of engaged users showing sustained uptake through registered data download								
Baseline	2014	2015	2016	2017	2018	2019	2020	Target
2013	Milestones foreseen							2020
1.0				1.5			2.0	2.0
	Actual results							
				13.8	30.0			

Comment: The 2013 baseline is 10 000 registered users, milestone of 2017 means a 50 % increase from the baseline, the target value means a doubling of engaged users. At the end of 2019, there were more than 300 000 users registered, demonstrating a steady increase in the number of users. About 20 % of the registered users are active ‘satisfied’ users (downloading a product at least once in the last quarter). The number of active users has been growing as quickly as the number of registered user, keeping the ratio stable.
Unit of measure: The figures are in 10 000

Indicator 2: Progression in number of satisfied users expressed by the percentage of returning and engaged users								
Baseline	2014	2015	2016	2017	2018	2019	2020	Target
2013	Milestones foreseen							2020
0 %		20 %		0 %			65 %	65 %
	Actual results							
				20 %	20 %			

Comment: Users’ satisfaction is expressed as percentage of Copernicus users which integrate the service products regularly into their workflows. About 20 % of the registered users are active ‘satisfied’ users (downloading a product at least once in the last quarter). The number of active users has been growing as quickly as the number of registered user, keeping the ratio stable.

Specific Objective 2: Providing sustainable and reliable access to spaceborne data and information from an autonomous European Earth observation capacity

Performance

Attention should be paid in ensuring for the future the continuity of the satellites operation and the evolution of the core Services, as well as the development of a competitive downstream market. New horizons for the use of space borne data and information have been opened by research and technological advances, for example through the interaction with Big Data and AI, new security concerns, and a renewed centrality of Copernicus data-based evidence to tackle the big challenge of climate change and implement the European Green Deal. In this framework the development of a new satellite mission dedicated to the monitoring of anthropogenic emissions could be of great help to achieve a zero emission society by 2050. Copernicus will have to find ways to

keep up with the international competition in the area of Big Data exploitation and help filling the gap EU has when compared with US or China.

Indicator 1: The accomplishment of the space infrastructure in terms of satellites deployed and data it produces for integration into geo-information services								
Baseline	2014	2015	2016	2017	2018	2019	2020	Target
2013	Milestones foreseen							2020
	1	2	4	7	7	7	8	8
	Actual results							
	1	2	4	6	7			

Comment: In terms of the number of satellites deployed.
Unit of measure: Total EU autonomous satellite capacity

Expenditure related outputs

Outputs(*)	Budget line	Budget 2020	
		Number	EUR million
Sentinel 1A, 2A, 3A, 1B, 2B, 3B, 5P operating	02 06 02	7	218,040
Sentinel construction of next series 1C&D, 2C&D, 3C&D, 5B&C, 6B	02 06 02	9	156,885
Total			374,925

Outputs	Number of outputs foreseen (F) and produced (P)							
		2014	2015	2016	2017	2018	2019	2020
Construction, launch and operation of satellites	F	1	2	3	1			1
	P	1	1	2	3	1		1

(*)The Copernicus satellites called Sentinels are currently being developed for the specific needs of the Copernicus programme. Sentinel-1 provides all-weather, day and night radar imagery for land and ocean services. The first satellite (Sentinel-1A) was launched on 3 April 2014. The second one (Sentinel-1B) was launched in April 2016. Sentinel-2 provides high-resolution optical imagery for land services. It will provide for example, imagery of vegetation, soil and water cover, inland waterways and coastal areas. Sentinel-2 also delivers information for emergency services. The first Sentinel-2 satellite was launched in June 2015 and the second unit was launched in March 2017. Sentinel-3 provides high-accuracy optical, radar and altimetry data for marine and land services. It measures variables such as sea-surface topography, sea- and land-surface temperature, ocean colour and land colour with high-end accuracy and reliability. The first Sentinel-3 satellite was launched in February 2016, the second unit in April 2018. Sentinel-5 Precursor is a satellite mission launched in October 2017 and it will contribute to reduce data gaps between Envisat and Sentinel-5. The other Sentinel no. 6 will be deployed after 2019.

Specific Objective 3: Providing a sustainable and reliable access to in-situ data, relying, in particular, on existing capacities operated at European and national levels, and on global observation systems and networks

Performance

The performance was satisfactory. The supporting indicators refers to the reliability of services based on the supply of data from local sensors. At the beginning, only 2 services were able to integrate the data from local sensors in their products and in 2016 all 6 services were integrating data from local sensors because in-situ data, issued from National, local sensors and the related networks were not available, hence the coordinating role of the European Environment Agency could not be successfully played on all services. The number of core services is not going to change unless a new one is going to be created (not planned for the next years). Some developments, however, may be implemented, for example the supply through inter-service platforms of specific products, for areas like CO2 anthropogenic emissions monitoring, coastal zones management, agriculture applications, tourism, cultural heritage protection.

Indicator 1: Sustained availability of in-situ data for supporting Copernicus services								
Baseline	2014	2015	2016	2017	2018	2019	2020	Target
	Milestones foreseen							2020
	2	4	6	6	6	6	6	6
	Actual results							
	2	4	6	6	6			

Unit of measure: Number of Services receiving in-situ data

Expenditure related outputs

Outputs	Budget line	Budget 2019	
		Number	EUR million
Products supplied operationally in response to user requirements in service component ‘Emergency Mapping Service’, ‘European Flood Alert system’, ‘Pan-European Land Cover’, ‘EU local land’, ‘Global land’, ‘Access to reference data’, and in services ‘Atmosphere Monitoring’ and ‘Marine Environment Monitoring’ services	02 06 01	8	N/A
Cross-cutting support activities and ramp-up phase of additional service components	02 06 01	1	1.4
Total		9	1.4

The numbers refer to the number of service components which produce operational geo-information products, or are receiving cross-cutting support activities. Service components are defined in the Copernicus Work Programme and multi-annual implementation plan, and are listed above under section 3.3.

4. Contribution to Europe 2020 Strategy and mainstreaming of policies

Contribution to mainstreaming of climate action

Relevant objective/output

Relevant objective/output	Budget 2019	Budget 2020
Delivering accurate and reliable data and information to Copernicus users (Copernicus Climate Change Service)	56,7	38,6
Delivering accurate and reliable data and information (satellite imagery, digital or printed maps) to Copernicus users (30 % of output produced relating to 3 Copernicus services on Land monitoring, Atmosphere Monitoring and Marine Environment Monitoring is attributed to Climate Change)	21,6	9,2
Output in terms of contribution made by data from Sentinel satellites (estimated to be some 34 % of Sentinel related budget)	196,8	164,8
Total	275,1	212,6

Programming climate action

2014-2018					2019-2020 estimates		Total
2014	2015	2016	2017	2018	2019	2020	
113,5	195,8	202,8	209,6	198,9	275,1	212,6	1 408,3

(*)The appropriations for the year 2014 have been reviewed to take account of the transfer to subsequent years of the allocations not used in 2014 (reprogramming exercise carried-out in 2015 in accordance with Article 19 of the Multiannual Financial Framework Regulation).

Justification

The Copernicus Climate Change service provides access to several climate indicators (e.g. temperature increase, sea level rise, ice sheet melting, warming up of the ocean) and climate indices (e.g. based on records of temperature, precipitation, drought event) for both the identified climate drivers and the expected climate impacts (6).

Contribution to financing biodiversity

Relevant objective/output

Relevant objective/output	Budget 2019	Budget 2020
Deliver accurate and reliable data and information to Copernicus users (The Copernicus Land monitoring service will provide information including on the dynamics of monitoring of biodiversity: operational continuity of Land Monitoring service is to be achieved by 2015 (30 % of output produced attributed))	9,3	3,4
Output in terms of contribution made by data from Sentinel satellites (estimated to be some 21 % of Sentinel related budget)	121,5	101,8
Total	130,8	105,2

Programming biodiversity

(6) The European Commission signed a Delegation Agreement with ECMWF (European Centre for Medium-Range Weather Forecasts) for the implementation of the Copernicus Climate Change service. It is operational since June 2018.

2014-2018					2019-2020 estimates		Total
2014	2015	2016	2017	2018	2019	2020	
64,5	97,3	98,9	107,8	101,6	130,8	105,2	706,1

(*)The appropriations for the year 2014 have been reviewed to take account of the transfer to subsequent years of the allocations not used in 2014 (reprogramming exercise carried-out in 2015 in accordance with Article 19 of the Multiannual Financial Framework Regulation).

Justification

The Copernicus land monitoring service provides geographical information on land cover and on variables related, for instance, to the vegetation state or the water cycle. It supports applications in a variety of domains such as spatial planning, forest management, water management, agriculture and food security, etc. The service is operational since 2012 (7).

5. Programme contribution to the Sustainable Development Goals

SDG 2 End hunger, achieve food security and improved nutrition and promote sustainable agriculture

‘The integration of statistics, geospatial information, Earth observations, and other sources of Big Data, combined with new emerging technologies, analytics and processes, are becoming a fundamental requirement for countries to measure and monitor local to global sustainable development policies and programs (United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) co-chair)’. In this framework Copernicus supplies crucial information (indicators/sub-indicators) for monitoring the progress of the following SDGs (8):

SDG 2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.

Copernicus Land Monitoring Service helps with data and products on crop indices, dry Matter Productivity and Soil Moisture.

SDG 3 Ensure healthy lives and promote well-being for all at all ages

SDG 3.d Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks.

Copernicus Atmosphere Monitoring Service (CAMS) supplies air quality forecasts on pollutants, CO2, NO2 levels, pollens levels

SDG 6 Ensure availability and sustainable management of water and sanitation for all

SDG 6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes
Copernicus Land Monitoring Service (CLMS) systematically provides in near real time information on global inland water bodies and their seasonal replenishment, lake and river water levels, temperature, turbidity and trophic state, including potential water availability from snow and ice cover.

SDG7 Ensure access to affordable, reliable, sustainable and modern energy for all

SDG7.3 By 2030, double the global rate of improvement in energy efficiency

Copernicus Atmosphere Monitoring Service (CAMS) provides global 5-day forecasts of desert dust and the other main aerosols (sulphates, sea salts, black and organic carbon).; Copernicus Climate Change Service (C3S) provides climate indicators of electricity consumption, alongside estimates of the combined production from all renewable sources

SDG 11 Make cities and human settlements inclusive, safe, resilient and sustainable

SDG 11.4 Strengthen efforts to protect and safeguard the world’s cultural and natural heritage.

The Copernicus Emergency Service can contribute to safeguarding cultural heritage by monitoring and documenting the impact of earthquakes through interferograms, which depict where the earthquake impact is most severe along with information for emergency response to different types of disasters, including floods, as well as related prevention, preparedness, response and recovery activities.

SDG 13 Take urgent action to combat climate change and its impacts

SDG 13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.

(7) The global component produces data across a range of biophysical variables at a global scale (i.e. worldwide), which describe the state of vegetation (e.g. vegetation condition index), the energy budget (e.g. land surface temperature, top of canopy reflectance) and the water cycle (e.g. soil water index).

The Pan-European component will produce 5 high resolution data sets describing the main land cover types: artificial surfaces (e.g. roads and paved areas), forest areas, agricultural areas (grasslands), wetlands, and small water bodies.

The local component focuses on ‘hotspots’ which are prone to specific environmental challenges. It provides detailed land cover and land used information (over major European cities, which are the first type of ‘hotspots’, i.e. the Urban Atlas.

(8) https://www.copernicus.eu/sites/default/files/2018-10/Copernicus_SDG_Report_July2018pdf.pdf

Copernicus Climate Change Service provides routine access to key indicators on a number of Essential Climate Variables (mean temperatures and anomalies, sea-ice extension, CO₂, etc.)

SDG 14 Conserve and sustainably use the oceans, seas and marine resources for sustainable development

SDG 14.4 By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics.

Copernicus Marine Monitoring Service offers monitoring of the oceanic carbon cycle, ocean PH and acidity, monitoring of fishing grounds. Effective maritime surveillance can help combat illegal, unreported and unregulated fishing, thereby contributing to sustainable fisheries goals. Copernicus Maritime Surveillance Service, can supply satellite data to ensure that fishing is carried out safely and sustainably

SDG 15 Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

SDG 15.1 By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements

Copernicus Land Monitoring Service delivers products for the protection of Natura 2000 areas for instance their grassland status and information on vegetation index, land degradation, deforestation and loss of biodiversity.

DG ESTAT is assessing the possibility to introduce in the future new Copernicus based sub-indicators for various SDGs.

SDG 17 Strengthen the means of implementation and revitalize the global partnership