# Chapter 5
# ESA's Earth Observation Strategy and Copernicus

**Josef Aschbacher**

In 2015, ESA adopted a new *ESA Earth Observation Strategy 2040*. The former strategy had been written some 20 years ago and was closely linked to the concept of the Living Planet Programme. With the Earth Observation Envelope Programme (EOEP) and the Earthwatch mechanism, the strategy overcame the approach of running isolated, one-off missions. The advent of Copernicus, discussed in more detail below, was a key factor in the decision to prepare an updated strategy. *ESA's Earth Observation Strategy 2040* covers the period from 2015 to 2040, with an interim progress review scheduled for 2025.

The new strategy builds upon existing elements, but also takes into account new developments and boundary conditions. It responds to societal challenges such as food, water, energy, climate, and civil security, while fully embracing the novel opportunities of the ICT revolution. Cloud-based access to Earth observation data, for the benefit of all levels of society, is a central element.

According to the new Strategy

> The vision of ESA is to enable the maximum benefit of Earth observation for science, society and economic growth in Europe, served by European industry. ESA will implement this vision through its Earth observation programmes, working in close cooperation with Member States, the EU, EUMETSAT and European industry within the widest international framework.

The Strategy sees ESA in an enabling, facilitating, and leading role, taking account of the strategies, objectives, and activities of the other Earth observation stakeholders in Europe. It also recognizes that: "*economic factors are of increasing importance in decision-making*" and attaches great importance to the service industry.

The *ESA Earth Observation Strategy 2040* is implemented through a number of programmes that are dedicated to both scientific (EOEP, Earthwatch, Climate Change Initiative) and operational demands (Copernicus, MetOp, Meteosat).

J. Aschbacher (✉)
Earth Observation Programmes, European Space Agency, Via Galileo Galilei, 00044 Frascati (RM), Italy
e-mail: josef.aschbacher@esa.int



M. Onoda and O.R. Young (eds.), *Satellite Earth Observations and Their Impact on Society and Policy*, DOI 10.1007/978-981-10-3713-9_5

Copernicus is a case in point, illustrating many of the concepts mentioned above. Copernicus, previously known as the Global Monitoring for Environment and Security (GMES) programme, is the most ambitious Earth observation programme to date. It will provide accurate, timely and easily accessible information to improve the management of the environment, understand and mitigate the effects of climate change, and ensure civil security. In essence, Copernicus will help to shape the future of our planet for the benefit of all.

Copernicus consists of a complex set of systems that collect vast amounts of data from multiple sources, including Earth observation satellites and in situ sensors (e.g., ground stations, airborne/seaborne instruments) and provides users with reliable and up-to-date information through a set of services related to environmental and security issues. These services fall into six main categories: land management, the marine environment, atmosphere, emergency response, security, and climate change. The European Commission (EC), acting on behalf of the European Union (EU), is responsible for the overall initiative, setting requirements and managing the services.

The Copernicus Space Component features a new family of dedicated satellites, called Sentinels, specifically for the operational needs of the Copernicus program. The Sentinels provide a unique set of observations, starting with the all-weather, day and night radar images from Sentinel-1A, launched in April 2014. Sentinel-1B followed in April 2016. Sentinel-2A and Sentinel-2B, launched in June 2015 and in March 2017, deliver high-resolution optical images for land services. Sentinel-3A, launched in February 2016, provides data for services relevant to the ocean and land. Sentinel-4 and -5 will provide data for atmospheric composition monitoring from geostationary and polar orbits respectively. Sentinel-6 will carry a radar altimeter to measure global sea-surface height, primarily for operational oceanography and climate studies. In addition, the Sentinel-5 Precursor mission will reduce data gaps between ENVISAT (in particular the SCIAMACHY instrument) and the launch of Sentinel-5.

The Copernicus Space Component is managed by ESA and serves users' satellite data available through the Sentinels and other Copernicus Contributing Missions at national, European, and international levels. As the architect of the Space Component, ESA coordinates satellite data delivery. The ground segment, facilitating access to satellite data, completes the Copernicus Space Component.

Policy makers and public authorities are the main users of Copernicus. Information supplied by Copernicus is used to develop environmental legislation and policies or to make critical decisions in the event of an emergency, such as a natural disaster or humanitarian crisis.

Copernicus is a prime example of successful cooperation between the EU and ESA in space matters and it marks the transition from scientific to operational Earth observation for the environment and civil security. It is a quantum leap in terms of coverage, data volume, revisit frequency, and long-term availability of satellite data. The full integration of operational users into the information chain is at the heart of Copernicus.

Copernicus is also a model for the future evolution of the EU-ESA relationship, and there are important synergies. The R&D and space infrastructure management expertise of ESA can help fulfill EU policy requirements. The EC can integrate space and its applications into relevant sectorial policies and deliver the necessary funding.

The socioeconomic impact of Earth observation has become a key argument to justify European investments. For Copernicus, independent studies conducted by Price Waterhouse Coopers and Booz & Allen have shown that, on average, EUR 1 invested in Copernicus leads to an economic benefit of up to EUR 10 due to better decisions, more efficient policy implementation, as well as savings due to better preparedness in case of natural disasters (ESPI 2011). Former Vice-President of the EC, Antonio Tajani, estimated that Copernicus would create up to 83,000 jobs in the EU by 2030. As another example, the European Association of Remote Sensing Companies (EARSC) estimates the economic value generated by the use of satellite imagery in supporting winter navigation in the Baltic Sea to be between EUR 24 million and EUR 116 million per annum alone.

Copernicus illustrates the various economic potentials of space. Classical business opportunities arise across the whole spectrum of the value-added chain, from development and manufacturing (upstream) to operations and services (downstream). However, the commercial potential of space also exists at a higher level. By providing platforms and infrastructure for information exchange and informed decision-making, space applications contribute to better governance, more efficient use of resources, and increased competitiveness. Furthermore, space utilization can yield evidence for long-term processes that increase knowledge and understanding as a basis for responsible action. This aspect of space is especially relevant to tackling the challenge of climate change. Reducing the impact of climate change will not only lead to economic savings, it will also allow countering societal challenges caused, for example, by droughts or food shortages, which are one of the prime causes of migration. Last but not least, space activities create benefits that are not always quantifiable in financial indicators, but that are tangible in providing better global information about the Earth's state and threats to its environment and people, thereby enhancing citizens' safety and quality of life.

There is another aspect of Copernicus relevant to the economic potential of Earth observation, namely the issue of data and information policy. In fact, the benefits mentioned above will only occur on a large scale if access to space-based data and information is full, free, and open, as in the case of Copernicus.

The issue of the data policy for Copernicus as a public endeavor touches upon the question of handling Public Sector Information (PSI). In principle, there are two ways of handling PSI that is meant for release—it can either be sold or given away for free. Data and information created by publicly owned infrastructure holds considerable value. However, this does not mean that it is economically wise to commercialize the data. The example of Landsat—a U.S. satellite program that had its data policy changed to free and open access in 2008—shows that the utilization of space-based information and its commercial exploitation increase significantly when it is supplied at no cost. In 2011, over 100 times more Landsat data was downloaded than in 2007.

A study by EARSC shows that the same effect can be expected for Copernicus (EARSC 2012). Free and open access to Sentinel data boosts economic activity and raises public tax income. These benefits, though time delayed, will outweigh the income that could have been generated by selling the data instead.

It should be recalled that raw data holds little commercial value. The value is created/increased by value-added products and services derived from the raw data—another motivation for providing the raw data for free to support the development of such products/services and to increase industrial competence within this sector. Young entrepreneurs need an open data policy to develop innovative businesses. Without an open data policy, returns will be much lower and barely recover investment costs.

To sum up these economic considerations, the Copernicus program's success depends on the widest possible availability and use of Copernicus data and information. Without free and open access and a long-term commitment to data availability, companies and users would not have invested in integrating the program into their services.

Beyond economic considerations, there are a number of other reasons why a free and open data policy has been adopted for Copernicus. Firstly, in general the EU itself advocates free and open access models to favor innovation, as demonstrated in its 2020 strategy for smart, sustainable, and inclusive growth, or in the PSI and Infrastructure for Spatial Information in the European Community (INSPIRE) directives, which aim to ensure the widest possible dissemination of environmental information held by public bodies. Moreover, the two directives share the objective of enhancing the transparency and availability of public data. In addition, Copernicus is the European contribution to Global Earth Observation System of Systems (GEOSS), which is based on the principle of free exchange of crucial satellite data and information. Furthermore, numerous (international) organizations, for example the World Climate Research Programme (WCRP) or the European Science Foundation (ESF), have voiced their strong advocacy of free and open data policies.

Looking outside Europe, the U.S., China, and Russia grant free and open access to satellite data. Since the provision of data to users takes place within an open world market, protection of European data would not have stopped others offering and sharing their data. Instead, it would have simply increased the dependency of scientists and value adders on non-European data. This would have been a strategic setback for Europe.

Last but not least, Member States, who invested significantly in establishing the space component, also advocated for a free and open data policy. Local governments and public bodies echoed the sentiment.

Accordingly, after some discussion, an overall Copernicus data and information policy based on the concept of free and open access was decided through the EC's Delegated Regulation (EU) No. 1159/2013, supplementing Regulation (EU) No. 911/2010. The overall Copernicus data and information policy enshrines the principles that had already been established for the Sentinel satellites. The key elements are that there are no restrictions, neither on the use (commercial and noncommercial) nor on users (be they European or non-European); that a free version of any dataset is available on the relevant dissemination platform; and that data and information are available worldwide, without limitation in time.

The FAO Forest Resources Assessments (FRA) of 2015 used Landsat and not Sentinel-2 data due to the uncertainty around the Copernicus data policy at the time of decision. Other similar programs would not have invested in either the ground segment or data assimilation strategies without guaranteed access.

There are market segments of space-based Earth observation where commercial models apply, for example in the data range of a resolution better than two meters (e.g., TerraSAR-X, COSMO-SkyMed, or Pleiades). The Sentinels, however, do not cover this market segment. If in the future a Sentinel (e.g., for security purposes) addresses such a market segment, the free and open data policy will have to be reviewed.

It should be stressed that a free and open data policy does not need to endanger commercial business models of Earth observation data providers. This is demonstrated by the case of Guyana. Despite having full terrain coverage from public data sources, Guyana also requires and purchases coverage from commercial sources to obtain higher resolution data for forest inventories. Sentinel data are very important for Guyana, but it continues to use complementary commercial data.

Copernicus is now a tangible reality with five Sentinels in orbit and more to follow soon. The volume of disseminated data is huge and rapidly growing, with more than 74,000 users registered on the Sentinel Scientific Data Hub and more than 24 Petabytes of data having been downloaded. The Copernicus services are in place or about to reach their full performance, with excellent user uptake. One can conclude that the right decisions have been made—Copernicus is up and running, it puts Europe at the forefront of operational Earth monitoring, and it delivers all kinds of benefits to citizens in Europe and around the world.

## References

EARSC (2012) About GMES and data: geese and golden eggs. http://earsc.org/file_download/134/Open+Data+study+Final+report.pdf. Accessed 7 Dec 2016

ESPI (2011) The socio-economic benefits of GMES. http://www.espi.or.at/images/stories/dokumente/studies/ESP_Report_39.pdf. Accessed 7 Dec 2016

## Author Biography

**Josef Aschbacher** began his professional career at the European Space Agency (ESA) in 1990 as a young graduate at the Centre for Earth Observation (ESRIN), Frascati, Italy. From 1991 to 1993, he was seconded as ESA representative to Southeast Asia at the Asian Institute of Technology (AIT) in Bangkok, Thailand. From 1994 to 2001, he worked at the European Commission's Joint Research Centre (EC/JRC) in Ispra, Italy, where he was, in his last position, the scientific assistant to the director of the Space Applications Institute. He returned to ESA in 2001 in the role of programme coordinator at ESA HQ, Paris, where he was responsible for advancing Copernicus activities within ESA and for international cooperation. He was promoted in 2006 to head of the Copernicus Space Office, where he led all activities for Copernicus within the Agency and with external partners, in particular the EC. In 2014, he was promoted to head of programme planning and coordination in the Directorate of Earth Observation Programmes, where he was responsible for planning the future actions and programs of the ESA Earth Observation Directorate and for formulating and implementing programmatic and strategic decisions across the Directorate. In 2016, he was appointed as ESA director of Earth observation.