






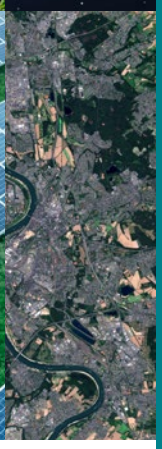


National User Uptake Strategy of the Federal Government

Use of satellite signals and data provided by the European Copernicus and Galileo programmes and the EUMETSAT meteorological programmes

Federal Ministry
for Digital
and Transport

Dear readers,

Whether for navigation, Earth observation or meteorology, data from space is indispensable for life on Earth and enhances and facilitates many aspects of our lives. The demand for data on the part of authorities, industry and the scientific community is already enormous and will continue to grow. For this reason, it is a good thing that the Copernicus and Galileo satellite programmes and the EUMETSAT meteorological programmes have made impressive progress over the past few years. We want to continue this success story. With this Strategy, the Federal Government is taking the use of satellite data to the next level.

The Strategy is the result of a participatory process. We have held in-depth and individual talks with around 150 experts from different sectors to integrate their findings, plans and suggestions into the Strategy. I would like to thank all stakeholders who have participated in this in-depth dialogue. It is our goal to focus this Strategy on user needs. We want to develop measures that simplify access to satellite data and services while opening up new applications.

The Strategy also builds on the strong commitment of the Federal Ministry for Digital and Transport. Not only was the Strategy developed under our lead responsibility, we are also working hard to implement it and enhance the satellite programmes.

This means harnessing the wide-ranging potential of the satellite data and services – for example by applying key technologies such as quantum computing and artificial intelligence. In this way, we are driving the digital transformation of our country. At the same time, we are making an important contribution to European sovereignty. Data and services 'made in Europe' also help us tackle the great challenges and tasks of our time – from climate change, infrastructure security and modern mobility to the digital transformation of industry and society.

This Strategy is our compass for the way forward. It provides a reliable framework to make optimum use of the opportunities and potential of satellite data and services for the common good. Let us continue to work on this and add new chapters to this success story.

I hope you enjoy reading this Strategy.

Dr Volker Wissing
Federal Minister for Digital and Transport

Copernicus data helps the forestry industry, for example to detect damage in the case of storm calamities, drought, forest fires or pest infestation.

Galileo is the world's most accurate satellite navigation system.

Precise weather data helps pilots to better assess hazardous situations.

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Summary

Our daily lives are characterized by a wide range of challenges for which data and services from the European Copernicus and Galileo satellite programmes as well as the EUMETSAT meteorological programmes open up fascinating solutions. Watering plants with pinpoint accuracy for best growth, landing aircraft safely even in difficult weather conditions, predicting how climate change will affect us in the future or knowing how best to respond rapidly, support rescue operations and save lives in the event of natural disasters: all this is made possible by modern satellite technology and the success story of European cooperation.

With this Strategy, we, as the Federal Government, want to draw attention to this potential and, above all, build on it. We will simplify and facilitate access to satellite data and services for users. By doing so, we want to make it easier to add value in Germany – for authorities, companies, organizations or our citizens.

Over the past few decades, the European Union Copernicus and Galileo programmes and the EUMETSAT meteorological programmes have become high-performance European space infrastructures that set global standards. This trend continues apace: new satellite generations and new technologies are continuously improving our understanding of the complex system that is Earth. This constantly inspires us to think of new ways to use satellite data and services.

The Federal Republic of Germany has been championing the continuity and development of these satellite programmes and their data and services for decades. As the European Union Member State with the highest financial contribution, we consider it important to harness the infinite potential inherent in the programmes, such as Earth observation via the Copernicus programme, precise positioning and timing made possible by the Galileo programme or the monitoring of climate and weather by the EUMETSAT meteorological programmes.

This is in our own interest as the Federal Republic of Germany and member of the EU, ESA and EUMETSAT, as Germany's future viability and productivity, our security and safety, our competitiveness, our commitment for climate action and environmental protection as well as European sovereignty are vital driving forces for expanding the programmes, including their satellites in space and their applications on the ground.

Data from the three satellite programmes is already supporting authorities, companies and organizations. It helps with the digital transformation of administration and business models and is an indispensable part of the everyday lives of many citizens. The programmes have already become success stories and flagships of European cooperation.

With this Strategy, we are continuing these success stories and have described the key action areas required to do so. We specify measures and formulate clear objectives for their implementation – in general and for each satellite programme. By doing so, we as the Federal Government define our mandate for the coming years. Specifically, the Strategy focuses on the following measures for the individual satellite programmes:

The Copernicus programme

For the **Copernicus programme,** on the one hand, we focus on user-driven development of the programme and on ensuring its continuity. On the other hand, we want to better involve users, enhance network structures and exchange formats and expand the range of information and training services. We want to achieve this by further developing Germany's national data platform CODE-DE in line with demand, expanding the German programme website and extending advisory, data procurement and other services for public administration, among other things. As a higher-level measure, we will expand the instruments necessary to promote innovation on the basis of Copernicus data.

The Galileo programme

For the **Galileo programme,** we are committed to better integrating Galileo services and enhancing the availability of the receivers. We aim to develop the range of Galileo services available, expand them in line with user needs and document them. Users are to receive better information or more advice and support to encourage them to use Galileo services. Moreover, we aim to increase the resilience of the Galileo services and update the regulatory framework to strengthen its use in critical infrastructure, for example. Finally, we want to ensure that the Galileo Open Service can also be used as a standalone system.

EUMETSAT

For the **EUMETSAT meteorological programmes,** we want to focus on a user-driven development of the available services and improving their quality. For this purpose, we want to upgrade user interfaces and perpetuate standardization initiatives, among other things. To harness the enormous potential inherent in technologies such as artificial intelligence, we want to push forward the integration of cloud systems for the processing of meteorological data and increase the use of existing services such as the European Weather Cloud. In addition, we want to upskill professional users from public authorities.

With this Strategy, we as the Federal Government are defining our mandate for the coming years. The European satellite programmes offer enormous potential to positively influence our lives and our future. With this Strategy, we as the Federal Government want to make the most of this potential – for the good of all.

Introduction

The European Copernicus and Galileo satellite programmes and the EUMETSAT meteorological programmes deliver ever-increasing volumes of signals and data.

There are many ways to process and use them. Data from these three operational programmes lays the groundwork for operational processes and business models that are in some cases existential for our life on Earth. High-precision navigation, weather forecasting or the monitoring of climate, nature and the environment, provision of remote sensing data for security authorities or infrastructure surveillance: satellite data makes a major contribution to a Government's civil and military capacity to act.[1] It helps authorities, companies, organizations and citizens to complete their day-to-day tasks. The data and signals are a key component of the digital transformation, and what is more: they make an important contribution to Europe's prosperity, security and sovereignty.

Copernicus is the European Union's Earth observation programme. It consists of a unique family of Earth observation satellites, in-situ monitoring systems and information services for data and information products. Copernicus provides information on land surfaces, the marine environment, ice coverage on oceans and continents, the atmosphere and climate change. The programme supports civil security and disaster management.

Galileo is a joint project of the European Commission, the European Union Agency for the Space Programme (EUSPA) and the European Space Agency (ESA). It gives Europe independent access to the key technology of satellite navigation. As the only global satellite navigation and positioning system under civil control in the world, it guarantees European independence from other systems and thus underlines Europe's sovereignty.

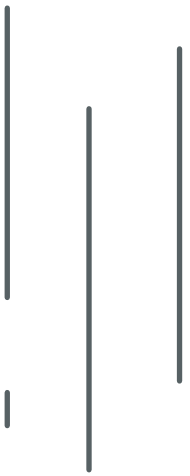
The **programmes of the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT)** deliver a wide range of data from European weather satellites for weather and climate monitoring. The data is a key basis for the models and services (weather monitoring and forecasting) of the National Meteorological Service of Germany (DWD), the European Centre for Medium-Range Weather Forecasts (ECMWF) and private weather services on the whole continent and beyond.

[1] See EUSPA EO and GNSS Market Report (2024), accessed at https://www.euspa.europa.eu/sites/default/files/euspa_market_report_2024.pdf

As the Member State with the highest financial contribution, the Federal Republic of Germany has for decades been championing the continuity and development of the three European operational satellite programmes. We as the Federal Government support the fact that the data, services and products based on Copernicus and Galileo as well as the EUMETSAT meteorological programmes can be used at national and European level. Many stakeholders from the public[2] and private sectors in Germany already harness them in various areas of application (see Figure 1).

The interest in and need for satellite data, services and products[3] from the three programmes has increased significantly and is continuing to rise – in particular against the background of climate change, security challenges and the digital transformation of authorities and businesses. As the provision of these satellite data, services and products becomes more and more demand-driven and user-friendly, satellite-based applications become increasingly interesting, also for new user groups. Technological and methodological innovations such as artificial intelligence (AI) facilitate the development of new business models and areas of application.

With this Federal Government Strategy on the use of satellite signals and data provided by the European Copernicus and Galileo programmes and the EUMETSAT meteorological programmes (in the following: 'Strategy'), we as the Federal Government affirm that we support users in harnessing the data and services of the satellite programmes and encourage them to do so, provide guidance about current application areas and strive to continuously expand usage options.



[2] This includes government stakeholders at all federal levels, including the military sector.

[3] 'Satellite data, services and products' includes everything from raw data and signals generated directly by satellites, to the services, products and applications developed by public and private sector value-added service providers using them as a basis. (see Figure 3)

Figure 1: *Sample areas of application of the satellite programmes in question*

We are strongly committed to aligning the European satellite programmes with user needs. Therefore, the Strategy is mainly based on the evaluation and analysis of around 150 in-depth talks and structured interviews held with users and experts. We focused our analysis on three aspects:

- First of all, we wanted to find out what applications already use data and services from the operational Galileo and Copernicus programmes and EUMETSAT.

- We also wanted to know what role the data and services play for the development of applications and products and how they are integrated into working processes.

- Finally, it was important for us to understand the ideas and potential users see in the use of the data and services concerned, and, specifically, the obstacles to the processing and use of the data and services and ways to overcome them.

The evaluation and thorough analysis of the talks and interviews serve as a sound basis and starting point for the five identified action areas of the Strategy and their measures.

By implementing the measures, we enable users to make greater use of the satellite data, services and products or even rediscover them. We will increase their popularity and enable users to harness them more consciously and adeptly. At the same time, we want to expand and enhance the provision of the data, services and products, enable closer cooperation between stakeholders and promote innovation. By doing so, we will optimize the Government's ability to act and contribute to Europe's sovereignty (see also the chapter entitled 'Federal Government objectives').

If specific measures or associated future measures lead to expenditure in the Federal budget, they are subject to the availability of budget funds or posts.

1.1 Strategic context

The Strategy is part of a broad operational and strategic context. Therefore, it has many interfaces with other (space) programmes.

Figure 2 shows how the Strategy is related to other strategies and projects at national and European levels. The Strategy is related both to other fundamental national strategy documents such as the National Security Strategy[4] and the Space Strategy[5] of the Federal Government as well as cross-cutting strategies of the Federal Government and the EU for the digital transformation of authorities, industry and society (e.g. Digital Strategy[6] of the Federal Government, 2022). It also supplements strategies related to specific programmes or organizations (e.g. the EUMETSAT Destination 2030 Strategy[7]) and updates the 2017 Copernicus Strategy[8] of the Federal Government, for example. Moreover, the Strategy complements various sectoral strategies (e.g. German Strategy for Strengthening Resilience to Disasters[9], 2022).

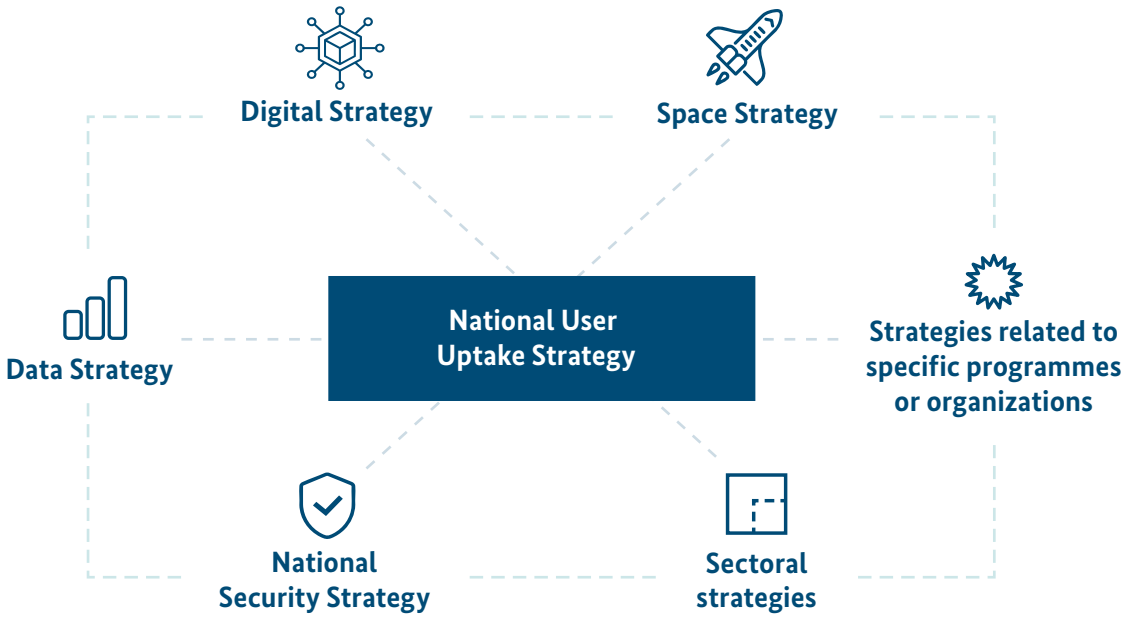


Figure 2: *Strategic context of the National User Uptake Strategy*

[4] https://www.bmvg.de/en/national-security-policy
[5] https://www.bmwk.de/Redaktion/EN/Publikationen/Technologie/the-german-federal-governments-space-strategy.html
[6] https://digitalstrategie-deutschland.de/static/eb25ff71f36b8cf2d01418ded8ae3dc2/Digitalstrategie_EN.pdf
[7] https://www-cdn.eumetsat.int/files/2021-09/EUMETSAT_Strategy_FULL_Online.pdf
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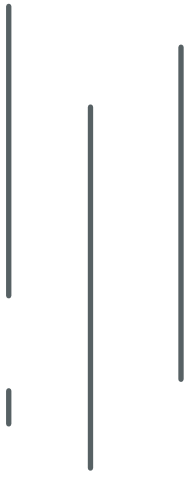
The Strategy offers a combined and coherent perspective on the complex context of national usage of the European operational Copernicus and Galileo satellite programmes as well as the EUMETSAT meteorological programmes. It is thus compatible with other strategic initiatives and can have synergetic effects.

Other important points of reference for the Strategy are research missions trialling new technologies – for example to monitor the environment and climate. While active, many of these missions deliver data that is then used in various routine applications, thereby laying the foundations for its long-term use. ESA's Earth Explorer research mission, for example, makes a significant contribution to the preparation of future operational Copernicus and EUMETSAT satellite missions.

With the European GOVSATCOM (Governmental Satellite Communications) and IRIS² (Infrastructure for Resilience, Interconnectivity and Security by Satellite) satellite communications programmes, other services and satellite infrastructure are currently being planned that, once operational, will ensure resilience, interconnectivity and security through satellite data-based applications. The objectives and measures of the present Strategy can be expanded in the event of further development to include, among others, the EU programmes EU SST (Space Surveillance and Tracking), GOVSATCOM and IRIS² and their respective operational applications.

The growing demand for and use of data, services and products of the programmes in question also cause dependencies and vulnerabilities on the user side, as the availability of the signals becomes increasingly important for critical services and capabilities. Failure of space systems caused by technical faults, accidents, inevitable effects of space weather or the behaviour of other space operators can have major consequences for all areas of society and the Government's ability to act.

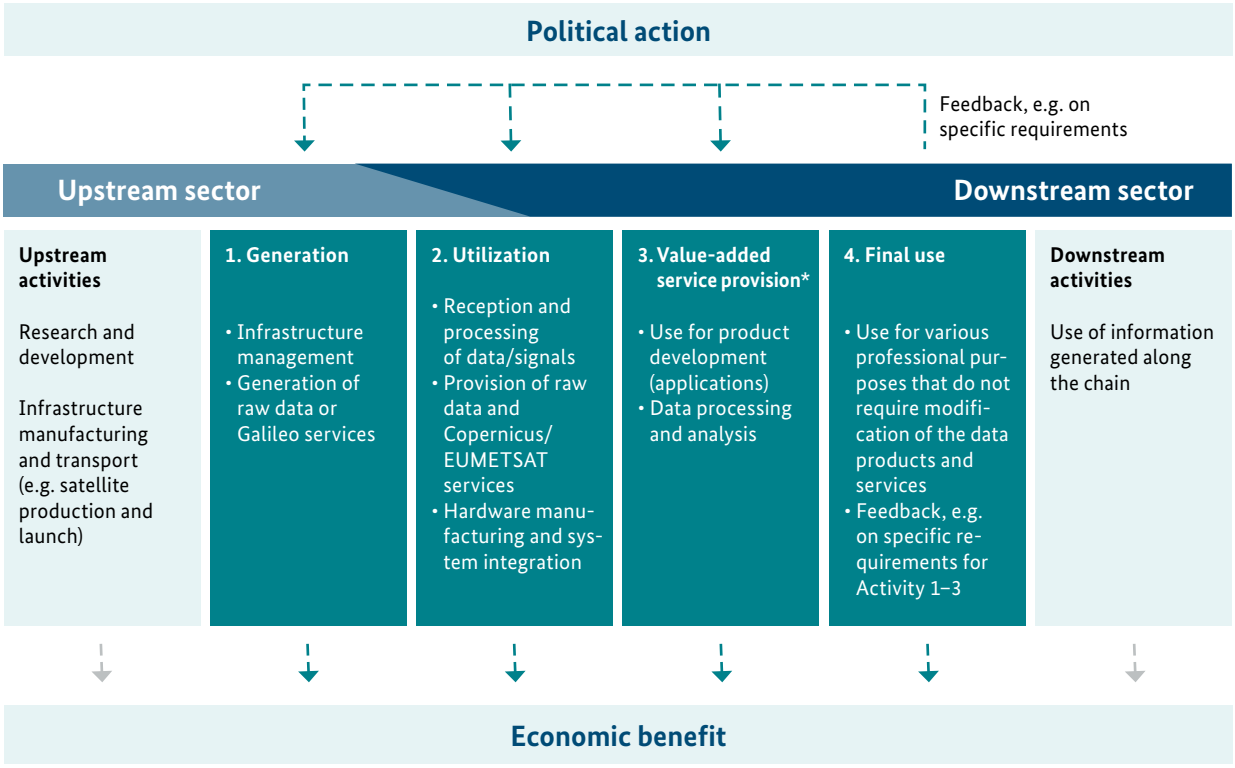
Specific aspects of these vulnerabilities resulting from the use of data, services and products from the programmes in question or other programmes are to be addressed in the Space Security Strategy, which is currently being developed. This Strategy therefore does not focus on them.



1.2 Focus on the downstream sector

The value chain (see Figure 3) of satellite infrastructure can be divided into upstream and downstream sectors. The upstream sector includes the development and manufacturing of space infrastructure (e.g. satellites), their transport into orbit and the installation of ground segments. In contrast, the downstream sector comprises provision of the data, services and products generated by the infrastructure.

This Strategy focuses on the use of operational data, services and products and refers to the downstream sector[10] of the programmes in question. We look at both public and private value-added service providers as well as end users in Germany. Value-added service providers are users that process and/or analyse data generated by satellites and the related services to make them available to end users as products (see Step 3 in Figure 3).



* Products may be provided via infrastructure from Step 2.

Figure 3: *Value chain of the European Copernicus and Galileo programmes and the EUMETSAT meteorological programmes*

[10] For Copernicus, the upstream sector is considered under value creation insofar as the procurement of commercial Earth observation data within the framework of the Copernicus Contributing Missions (CCM) give the providers of such data, for example NewSpace start-ups, a sales opportunity.

Federal Government objectives

2.1 Vision and success factors

The Strategy consists of four elements (see Figure 4). The vision is the starting point of the Strategy. It shows that the use of the satellite programmes in question has already reached a high level while also showcasing ways to further optimize it. Based on six success factors, we specify the objectives of the Strategy and highlight how they will contribute to realizing the vision. Five cross-programme action areas structure the implementation of this Strategy and form the framework for actual programme-specific measures. The backgrounds and objectives of the measures are described in chapters 3, 4, and 5, which focus on the respective programmes.

Vision

The comprehensive use of high-performance satellite data, services and products 'made in Europe' by public and private sector stakeholders is an essential basis for **Germany's safety and security and its ability to assess situations and act accordingly.** The provision of this infrastructure is based on user needs and contributes to **Europe's sovereignty** as well as **value creation and competitiveness.** It thus **future-proofs Germany,** ensures its **productivity** and supports **climate action and environmental protection.**

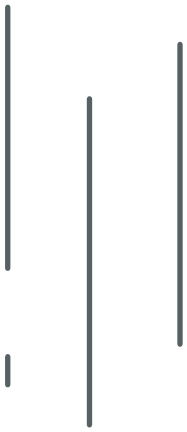
The points highlighted in the vision are our motivation to present and implement this Strategy – in order to perpetuate, optimize and expand the use of satellite data, services and programmes. They can be described as follows:

Strengthen safety and security, Germany's ability to assess situations and act accordingly, as well as Europe's sovereignty: The satellite programmes in question deliver essential data, services and products. We need them to maintain public safety, security and order or protect critical infrastructure (KRITIS), for example. We also use them for civil[11] and military defence and disaster management. The availability of European data, services and products safeguards German and European independence from private and non-European satellite programmes. Its availability also contributes to resilience vis-à-vis external influences and foreign policy developments, thereby strengthening Germany's internal and external security.

Boost value creation and competitiveness: The broad (and largely) free availability of data, services and products from the programmes enables companies to optimize their existing business models and develop new, innovative business models.

[11] Civil defence comprises planning, preparation and performance of all civil measures required for the restoration and maintenance of defence capability, including the supply and the protection of the civilian population; see Framework Guidelines for Overall Defence (RRGV), p. 19 – in German only.

Companies can use satellite data, services and products to increase efficiency in their fields of activity or take commercial business decisions. Private-sector actors can also contribute to developing the technology and contents of the programmes (e.g. in the form of information products, additional commercial data or satellite infrastructure elements). This generates growth, boosting the national and European economies, international competitiveness and Germany as a location for the aerospace industry.



Strengthen Germany's future viability and productivity: By publishing data, services and products from the European satellite programmes and making them available to public and private sector stakeholders, we create the foundation for a digital and modern state. Public authorities can quickly access a reliable decision-making basis, enabling them to carry out actions more efficiently and thoroughly.

Support climate action and environmental protection: Data, services and products from the European satellite programmes are a key instrument for monitoring environmental and climate-related trends continuously and comprehensively. They provide an essential basis for private and public sector stakeholders to develop specific improvement and adaptation measures.

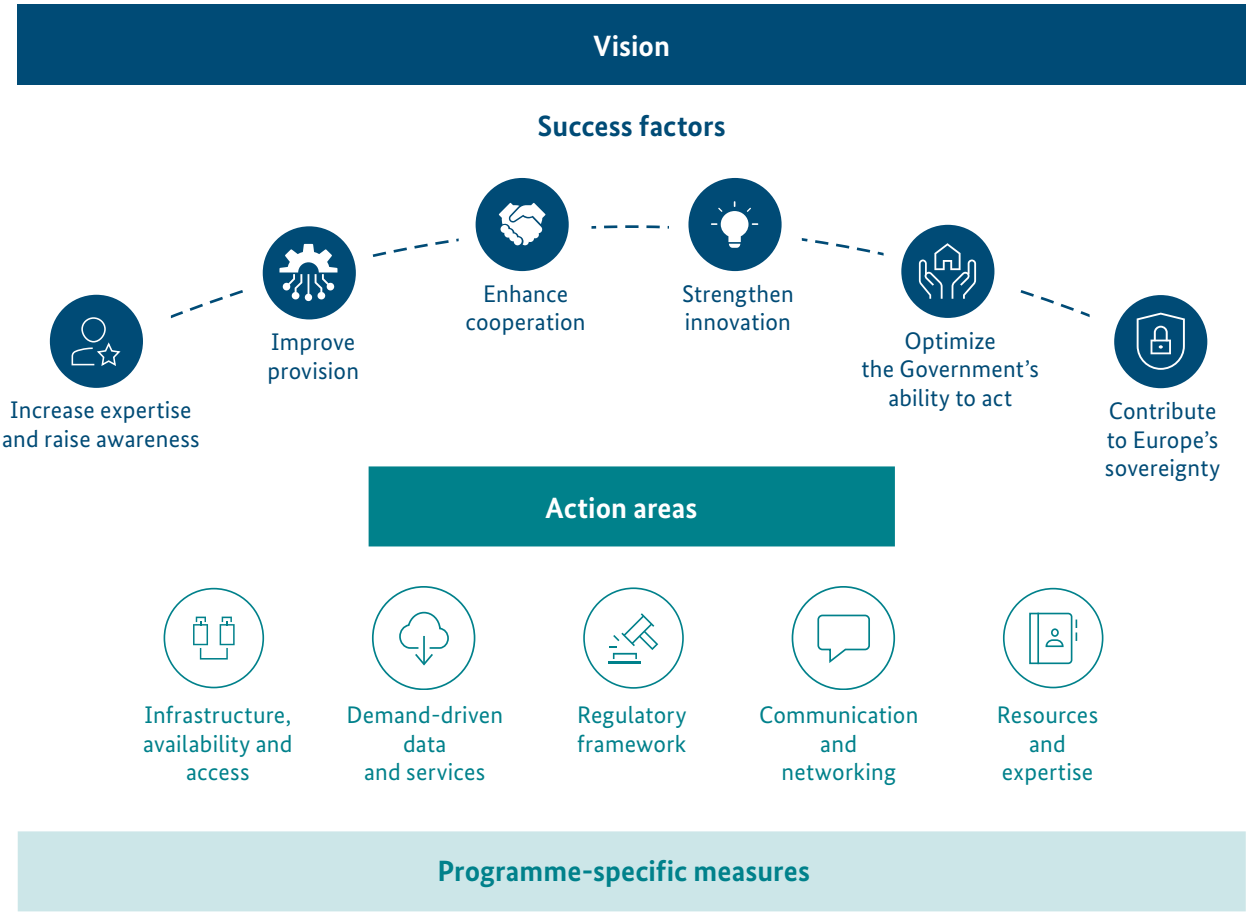


Figure 4: *Diagram of the structure of this National User Uptake Strategy*

Success factors

The Strategy and its vision are in line with the Federal Government's long-standing commitment to European satellite infrastructure. It ensures that data, service and product provision is improved and increases their use. Implementing the Strategy will thus add value for society and the economy. The following success factors contribute to fulfilling the vision:

Success factor – increase expertise and raise awareness

Increase **expertise in handling** satellite data, services and products, along with raising **awareness** and **understanding** of their **value** in both the public and private sectors as well as among citizens

To be able to use the data, services and products from the European satellite programmes in question, potential user groups must be aware of them. Moreover, there must be an awareness of the use cases and potential they facilitate that user groups accept.

The Strategy helps to close existing knowledge gaps. We want to provide users with targeted information and enable them to build appropriate skills. This helps them to acquire skills and learn how to use data, services and products from the European satellite programmes.

Success factor – improve provision

Increase the **demand-driven and reliable provision** of the data, services and products to also enable **interoperable usage** in particular

To enable users to apply and use satellite data, services and products, high-performance and modern infrastructure must be in place to deliver access or reception options. The data, services and products must be made available in line with user needs and in high quality, and provided on time. Interoperable usage also makes sure that data from different domains (e.g. mobility data) dovetails seamlessly. With this Strategy, we are introducing measures at national level that safeguard reliable access or provision and allow and simplify usage of the data and services for applications.

Success factor – enhance cooperation

Enhance **cooperation** between **sectors and federal levels** and strengthen the role of **value-added service providers and multipliers**

With this Strategy, we will promote cooperation and networking between and within sectors and value chain levels to allow the value of the data, services and products to be successfully and sustainably leveraged. This is to generate synergies and inspire innovation. In particular, we will enhance cooperation between the federal levels in the development of applications on the basis of satellite data, services and products.

Public and private sector value-added service providers and other multipliers play a significant role in delivering demand-driven solutions and knowledge transfer.

Success factor – strengthen innovation

Support **new applications that add value** and **innovative methods**

The potential inherent in the use of data, services and products from European satellite programmes is nowhere near exhausted. By implementing this Strategy, we are contributing to enabling new developments in areas of application that add value and are relevant for society – both by private sector and public sector stakeholders. We are laying the foundations for increased use of new and forward-looking processes and tools, such as artificial intelligence, digital twins or quantum technology. In particular, we are promoting innovative use of data and services in existing and new areas of application.

Success factor – optimize the Government's ability to act

Boost the **use of satellite data, services and products in public administration and governance**

By implementing this Strategy, we make sure that satellite data, services and products from the programmes in question will be used in even more areas and more frequently as a basis for actions and decisions. This will make performing state functions more transparent, efficient and outcome-oriented. This also applies to areas where the data, services and products contribute to enhancing civil security.

Success factor – contribute to Europe's sovereignty

Secure the operation and **continued development** of the satellite programmes in question

The programmes in the focus of this Strategy contribute to Europe's sovereignty, reducing dependence on non-European providers. As the Member State with the highest financial contribution, Germany has been continuously advocating long-term operation of the satellite infrastructure and their alignment with user needs. At the same time, the infrastructure in space and on the ground must be adequately protected. Awareness must be raised among users that this European infrastructure is vulnerable, in particular in a tense geopolitical context.

2.2 Overarching action areas

To achieve the strategic objectives of the Strategy, we have defined several action areas, which are underpinned by specific measures. Even though the action areas and resulting activities differ among the programmes, five cross-programme action areas can be identified that form the framework for the development of measures (see Figure 5).

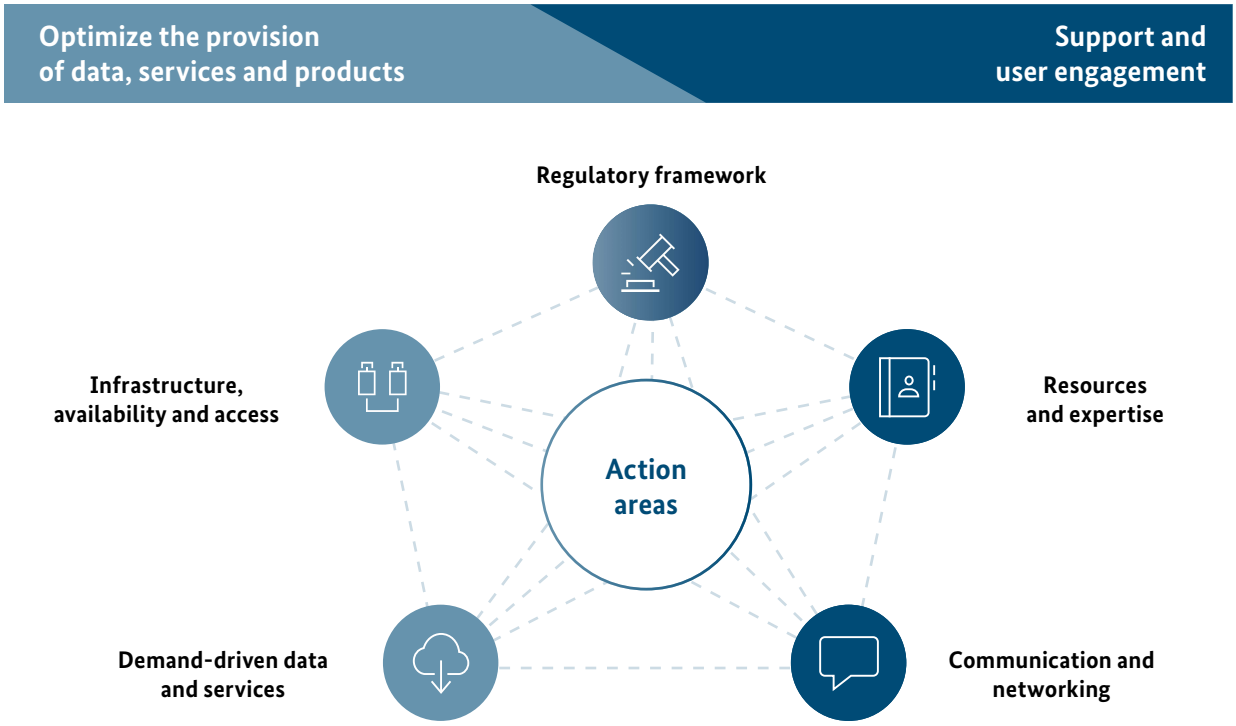


Figure 5: *Overview of the action areas*

The five action areas include 'Optimize the provision of data, services and products' (supply side) and 'Support and user engagement' (demand side). The action areas are mainly derived from the results of a survey among around 150 users and experts conducted by the Federal Ministry for Digital and Transport to develop this Strategy. The action areas contribute to removing the obstacles identified during the user survey and fulfilling the needs of the users.

Providing a working, cost-effective and secure satellite infrastructure that is available in the long term is an essential basis for the use of the data, services and products.

In the **Infrastructure, availability and access** action area, we pool measures to optimize the high-performance provision of data and services and ensure their long-term availability. We also link this with the technological and methodological usage options of the signals and data from the programmes. In addition to hardware and ground segments, we also address data platforms and interfaces. We take a look at basic issues such as long-term availability and development of the programmes, as well as frequency and spectrum management and the security of the systems themselves. At the same time, the programmes are continuously and closely tailored to user needs – with close support from relevant research and development measures. As the Member State with the highest financial contribution, we continuously advocate these objectives in the competent bodies of the institutions concerned.

The **Demand-driven data and services** action area focuses on upgrading the quality of data and services, improving standardization, ensuring integrity and remaining strongly focused on user needs. An additional focus is on strengthening the development of innovative value-added services. Starting points here are standardized descriptions of the data lifecycle or the way data is manipulated and aggregated, as well as the provision of tools for data and service processing. As in the context of the technical infrastructure, the measures relate in large part to contributions that we, as the Federal Government, make at European level to expand and evolve the programmes.

The measures of the **Communication and networking** action area are intended to perpetuate and expand information and exchange services for (potential) users of the data, services and products. This includes enabling users to communicate their wishes and needs to an appropriate body. By perpetuating communication services tailored to addresseees, we want to close information gaps, open up communication channels and make new applications possible.

The measures of the **Resources and expertise** action area also aim to support (potential) users of the data, services and products. Our analysis of the status quo of the use of the programmes shows that new requirements and ideas are often hampered by a lack of time, funding or technological resources and personnel. Therefore, we want to launch initiatives aimed at a better use of resources and expertise.

A reliable regulatory framework for the use of the data, services and products is an essential basis for expanding their usage – in particular in sensitive areas of application. This is why we lay down in the **Regulatory framework** action area how the external, and particularly the legal framework (e.g. Federal legislation or administrative regulations) can be designed and adapted for the use of satellite data, services and products.

The European Copernicus programme

3.1 Programme and stakeholders

Copernicus has served as the EU's operational Earth observation programme since 2014. At the core of Copernicus are the dedicated Sentinel satellites, each of which uses different measurement methods to collect data for various areas of application. Copernicus is complemented by data from over 30 contributing satellite missions. Copernicus also collects information from in-situ systems, which gather data using a variety of sensors on the ground, at sea or in the air. The Copernicus services convert this wealth of data into reliable information products of assured quality.

There are six Copernicus services in the following fields

- Land monitoring
- Marine environment monitoring
- Emergency management
- Atmosphere monitoring
- Climate change monitoring
- Security

These services routinely provide spatially explicit, comprehensive information and data products for Europe and, in some cases, beyond. In addition to the services, users can also use the Sentinel data directly. Access is possible via various platforms at both the European[12] and national levels – in Germany for public stakeholders in particular via the CODE-DE[13] portal. The Sentinel data and Copernicus services are openly accessible[14] and free of charge – whether for public authority users, the scientific community, commercial companies, start-ups, non-profit organizations or citizens.

The implementation and further development of the Copernicus programme is characterized at both the European and national levels by a variety of stakeholders who must be taken into account when implementing the national Strategy.

[12] With the Copernicus Data Space Ecosystem (CDSE), the European Commission and ESA created a new central data platform at European level in early 2023 that ensures the continuity of open and free access to Copernicus via a central portal and expands the range of data processing and data access options: https://dataspace.copernicus.eu/

[13] The CODE-DE (Copernicus Data and Exploitation Platform – Germany) cloud platform has been financed by the BMDV since 2017 and provides German users, in particular public authorities, with BSI-certified access to Copernicus data, tools and resources for direct processing of the data in the cloud and individual user support: https://code-de.org/en/

[14] Except for the security services and some applications for emergency management.

European level

ESA is responsible for developing the space segment component of the Copernicus programme. Together with EUMETSAT, it is also responsible for operating the Sentinel satellites.[15] ESA and EUMETSAT moreover coordinate the delivery of data from the more than 30 contributing missions, which in turn are operated by various national, European or international organizations and companies.

The Copernicus ground segment relies on existing infrastructure operated by ESA, EUMETSAT and national agencies (public and private).

The Copernicus in-situ component is coordinated by the European Environment Agency (EEA).

The six official Copernicus services are operated and evolved by various European organizations and institutions:

- Land monitoring: EEA and EU Joint Research Centre (JRC)
- Marine environment: Mercator Océan International (MOI)
- Atmosphere: European Centre for Medium-Range Weather Forecasts (ECMWF)
- Climate change: ECMWF
- Emergency management: JRC
- Security
  - Component for security and EU foreign policy: European Union Satellite Centre (SatCen)
  - Border surveillance component: European Border and Coast Guard Agency (Frontex)
  - Maritime surveillance component: European Maritime Safety Agency (EMSA)

National level

In Germany, the Federal Ministry for Digital and Transport has lead responsibility for the Copernicus programme. It consolidates national interests in the evolution and use of Copernicus and provides the budget for the German contribution to the Copernicus programme.

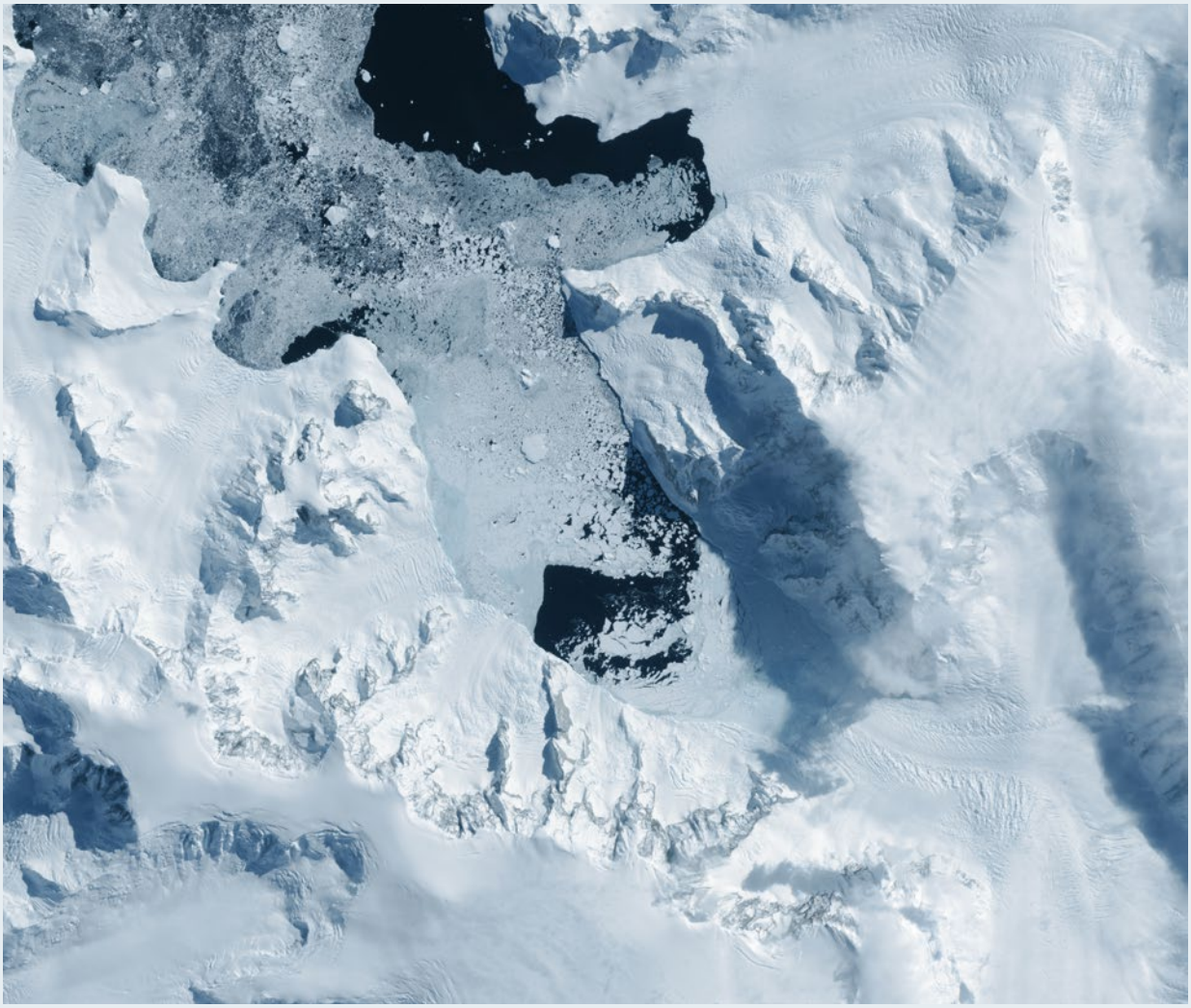
As the Federal Government, we have, by means of an Interministerial Committee for Geoinformation (IMAGI) resolution, appointed national Copernicus coordinators who are based in specialized authorities under various government departments. They have supported us for many years in informing, coordinating and networking national stakeholders and serve as contact persons for German users regarding technical questions within their area of specialization. The network is supplemented by Copernicus experts whose support focuses on specific areas of application.

[15] ESA operates the Sentinel-1, Sentinel-2 and Sentinel-5P satellites. ESA also ensures the operation of the land monitoring mission of Sentinel-3. EUMETSAT is responsible for operating the Sentinel-3 and Sentinel-6 satellites as well as implementing the marine environment mission and will also operate and deliver products from the Sentinel-4 and 5 instruments.

Sample application: Monitoring sea ice with the help of Copernicus

Challenge: During the winter, ice can form along the German coast, affecting the safety and seamless operation of shipping. In such cases, the ice service of the Federal Maritime and Hydrographic Agency (BSH) prepares daily ice charts and provides further information.

Added value of Copernicus data: The ice service uses Copernicus data, weather information from the DWD and feedback from voluntary observers to localize ice on the coasts precisely and in good time. It draws on many sensors of the Sentinel satellites and benefits from the easy and clearly structured data access. In particular, Sentinel-1 radar data is an indispensable source of information for the ice service due to its independence from light and cloud cover and the free and timely provision by Copernicus.



Sentinel data supports the monitoring of sea ice.

Copernicus is also a major contribution by Europe to the international Group on Earth Observations (GEO),[16] which addresses the application of Earth observation to global issues, e.g. within the framework of the UN Sustainability Goals and the UN Framework Convention on Climate Change. Copernicus is also being used extensively in the Destination Earth (DestinE)[17] and European Digital Twin of the Ocean (EU DTO)[18] EU initiatives, which aim to develop and provide digital twins of the Earth and the ocean.

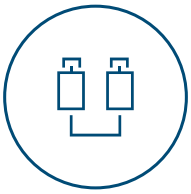
3.2 Action areas and measures

With the Copernicus work programme, we as the Federal Government formulated measures to implement the national Copernicus Strategy for the first time in 2018. With its update in 2022, we aimed to significantly strengthen the integration of Copernicus data and services even further and to set new priorities. This included not only the continuous provision and testing of new products, but also the use of new methods to evaluate Earth observation data, for example using artificial intelligence. With this Strategy, we are updating the national Copernicus Strategy of 2017. The 2022 Copernicus work programme with its ongoing activities continues to apply and is to be integrated into the monitoring of the Strategy. The measures below provide the strategic framework for this and set additional priorities.

[16] The intergovernmental Group on Earth Observations, established in 2005, set itself the goal of better coordinating global Earth observation infrastructure and the data and information obtained from it, and making them available worldwide. Germany has been supporting GEO as a member since its foundation: https://earthobservations.org/

[17] Destination Earth, or DestinE for short, is a flagship initiative of the European Commission's Digital Europe Programme (DEP): https://digital-strategy.ec.europa.eu/de/policies/destination-earth and https://destination-earth.eu/. DestinE aims to combine extensive data from Earth observation (in particular Copernicus data) and the social economy with models of the Earth system and various economic sectors as well as artificial intelligence applications. A central access platform will provide users with access to a wide range of tools for data analysis and visualization to generate information that enables data- and science-based action, e.g. with regard to climate change adaptation.

[18] European Digital Twin of the Ocean, or EU DTO for short, is an EU-funded project that aims to create a virtual representation of the marine and coastal environment around the globe, which will enable the testing and assessment of future impacts of climate change and human activities, making knowledge about the oceans more accessible and impactful than ever before: https://www.edito.eu/



Action area ‘Infrastructure, availability and access’

Copernicus represents a milestone in the public generation and provision of data and information. The programme is a success for Europe as a community. Users from all sectors and stages of the value chain particularly appreciate the free availability and often high temporal resolution of the Sentinel data and the products derived from it. As a freely available resource, Copernicus is a relevant basis for addressing a range of issues and for knowledge-based decision-making in politics and administration, as well as in business and science. Many stakeholders, particularly in the public sector, are already actively using the products derived from the programme and are integrating them into their day-to-day operations. The core of this action area is, on the one hand, to ensure the availability and usability of Copernicus data and services for German users and, on the other hand, to safeguard the continuity and evolution of the Copernicus programme at the European level and to help shape it programmatically.

To enable users to utilize Copernicus data, services and products even more intensively and efficiently, simple, easy to find[19] and secure access to them is just as important a prerequisite as high-performance data infrastructure that is available in the long term as well as secure services for cloud-based processing and interoperability with complementary data sources. We therefore want to expand and further improve existing structures, such as CODE-DE, as part of this action area. In light of these aspects, the following measures are planned for the Copernicus programme in the ‘Infrastructure, availability and access’ action area:

[19] At the end of 2023, four thematic Copernicus hubs were launched at the European level to serve as central access points to data and products generated by various Copernicus services for specific regional or thematic areas. This makes it easier for these user groups to find the data and products they need for their applications. The hubs currently focus on the topics and regions of energy, health, coastal areas and Arctic regions. Further hubs are in planning.

Measure COP-HF 1.1: Ensuring the continuity and user-driven evolution of the Copernicus programme

Description:
As the Federal Government, we are keen to proactively raise our national interests regarding key issues of the programme in the relevant ESA- and EU-level committees. Topics include defining and evolving services, data access, data policy, the in-situ component and the priorities for the evolution of the space component.

In this way, we are contributing to shaping the content of the Copernicus programme as well as to the long-term technical evolution of the Copernicus space and ground segments and their protection.

Objective:
- Users can rely on the long-term and secure operation of the programme and thus have planning security.

Contribution to the success factors:[20]

Measure COP-HF 1.2: Demand-driven and long-term provision and development of CODE-DE

Description:
CODE-DE is the central platform for public sector stakeholders in Germany to access Copernicus data quickly and efficiently and process it directly in the cloud. We want to provide these CODE-DE services on a long-term basis. In addition, we want to further improve and expand them in line with the specific needs of their users in terms of the technical potential, the service portfolio and user-friendliness. In order to take account of the ever-increasing relevance of AI methods and to expand the available data basis to include national missions and NewSpace providers, we will furthermore merge CODE-DE with the AI-focused 'EO-Lab' platform. This future 'CODE-DE Lab' will provide users with AI training data, among other things, as well as separate resources for research and development of and with AI methods that make the use of AI algorithms particularly efficient.

[20] Legend for 'Contribution to the success factors'; greyed-out symbols indicate that no specific contribution is made.

Furthermore, we want to enable users to share sample applications or developed products and software tools with each other via the platform. We will also ensure the best possible integration with other services and platforms, as well as with complementary data sources, e.g. via appropriate interfaces. This also applies to the high-resolution remote sensing data that is commercially procured by the Federal Agency for Cartography and Geodesy (BKG) and is to be made available free of charge to all Federal agencies via CODE-DE for subsequent use. With this measure, we are also supporting 'Cloud platforms for climate and environmental data', one of the key projects of Germany's 2023 Space Strategy.[21]

Objectives:

- Users can easily find suitable data and products that are available in the Federal administration and process them for their tasks. This ensures a high degree of transparency and suitability for subsequent use of products, tools and applications.
- The development of Copernicus-based products via and on CODE-DE will remain possible also in the future in a secure manner and in the long run.
- The integration of the new CODE-DE Lab results in an increased use of AI methods.

Contribution to the success factors:

Copernicus provides valuable data on inland waters, including the adjacent forelands and whole catchment areas. The parameters recorded include, among others, turbidity and water quality, as well as the distribution of vegetation and sediments. This data is of great importance for official uses in water monitoring. This Sentinel-2 image shows the Rhine between Cologne and Bonn.

[21] see p. 34: https://www.bmwk.de/Redaktion/EN/Publikationen/Technologie/the-german-federal-governments-space-strategy.html

Action area ‘Demand-driven data and services’

Due to the spatial resolution of the Sentinel data, it is particularly well suited for large-scale monitoring tasks. It is already being used for this purpose in many areas, e.g. environment, vegetation and water. Compared to conventional methods, such as aerial surveys or on-site inspections, Copernicus can provide uniform, comprehensive and cross-border information faster. This means that areas can also be observed between selective on-site measurements and, if changes are detected, can then be analysed in greater detail with higher-resolution data (e.g. from commercial satellite missions or aerial surveys) or via on-site inspections. In addition, Sentinel data is often used for low-cost proof of concept studies to examine the potential of Earth observation data for a particular area or application. If needed, higher-resolution commercial data is then used (complementarily) for the actual implementation. For example, the BKG makes available high-resolution remote sensing data free of charge to all Federal agencies via the Federal Service Point of Remote Sensing. In addition, the BKG, through its Satellite-Based Crisis and Situation Service (SKD), also offers end products based on Copernicus and in-situ data that are tailored to specific needs (e.g. situation maps, analyses, dossiers). Users receive close and individual support and training in how to use the data. To combine user needs, regular surveys are conducted on the requirements, and the results are published.

In addition to the wide range of operational uses in a variety of areas, Copernicus is therefore an easy entry point to the field of satellite-based remote sensing for many stakeholders. The programme also stimulates the market for commercial data. Germany’s development cooperation goals can also benefit considerably from Copernicus.

In-situ data is another essential component of Copernicus. It is necessary for the provision of Copernicus services and used for the calibration and validation of satellite missions. In-situ data also represents an important information base in its own right and supports Copernicus users in the (further) development of products and services based on Copernicus data.

It is essential to consistently focus on user needs in order to increase the actual use of Copernicus programme data and services, as well as of products based on them. The focus of this action area is therefore on strengthening and expanding existing structures for national user participation and for exchanging ideas on the (further) development of the Copernicus services. In light of these aspects, the following measures are planned for the Copernicus programme in the ‘Demand-driven data and services’ action area:

Measure COP-HF 2.1: Strengthening user participation in the (further) development of Copernicus services and products

Description:
To ensure that the services and products achieve a long-term impact, it is important to actively and continuously involve users in their (further) development. Copernicus coordinators and their involvement in the relevant European committees play an important role in improving the Copernicus services in terms of their content and product portfolios in line with German user interests. We are therefore continuously advancing existing processes with which we systematically identify the interests of German users.

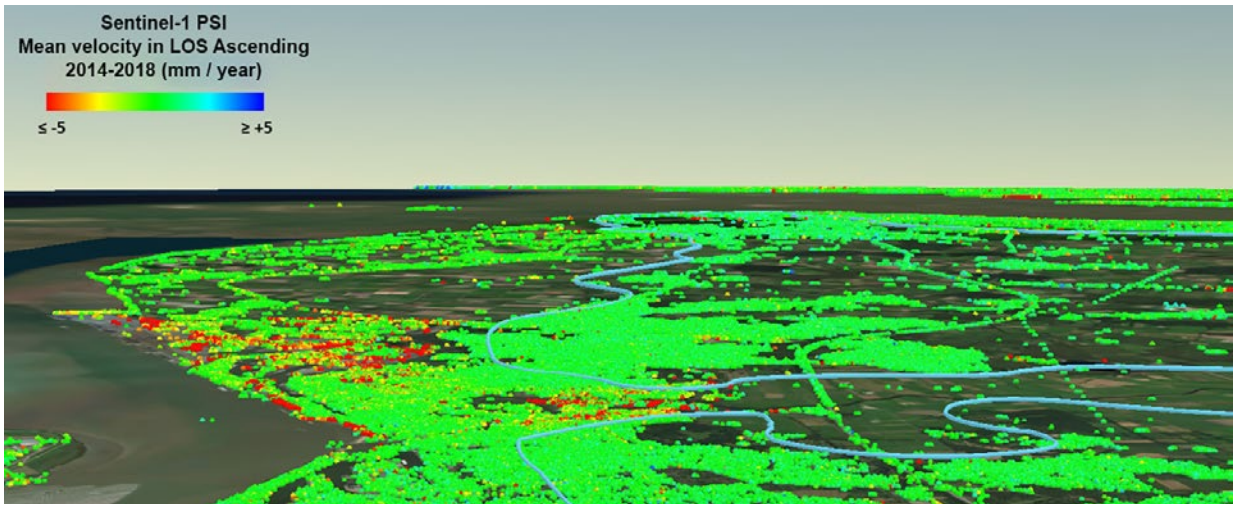
Furthermore, the specific design of commercial products based on data from the Copernicus programme is to be more closely aligned with user needs. To this end, structures for continuous user participation in product development should be specifically promoted on the one hand, and regular exchange between product developers should be enhanced on the other hand.

Objectives:
- German user interests are continuously considered in the evolution of the Copernicus services.
- Commercial value-added services based on Copernicus are continuously improved by including users in the development processes at an early stage and on an ongoing basis.

Contribution to the success factors:

Measure COP-HF 2.2: Increasing the availability and interoperability of complementary data

Description:
To meet the needs of many users, data from the Copernicus programme is often combined with complementary data (e.g. maps, survey/cadastral data, etc.), which, however, in many cases has a different format. In order to be able to use AI-based applications in data evaluation, standardized data formats are an important basis. The same applies to in-situ data, which is an essential component of Copernicus, but whose use is complex and often limited for end users – not only due to different data formats and data structures, but also due to a lack of knowledge about its availability, a lack of incentives or an inadequate legal framework for its provision. We will therefore identify potential for more standardization and interoperability, as well as demand-oriented and legally certain availability of in-situ data and other complementary Earth observation data. To this end, we will develop implementation options in dialogue with relevant stakeholders across federal levels. At the national level, for example, the BKG's Satellite-Based Crisis and Situation Service (SKD) combines Copernicus data and services with in-situ data. On CODE-DE, users can upload their own in-situ data and combine and process it with Copernicus data directly in the cloud.



Ground subsidence often occurs as a result of underground changes such as groundwater extraction, mining and urbanization and can cause significant damage to buildings and infrastructure. Radar data from the Sentinel-1 mission shows ground deformation in the Bremerhaven area, particularly in built-up marshland (red and orange dots). Regular monitoring enables authorities and planners to monitor endangered areas in a targeted manner and take measures in good time, thus minimizing economic losses and safety risks.

Objectives:

- Users combine Copernicus data with the complementary data required for their applications easily and ideally in an automated manner.
- National Copernicus and complementary in-situ data is available to end users for their applications within the scope of what is legally possible.
- National services such as CODE-DE and the SKD enable users to integrate in-situ data.

Contribution to the success factors:

Measure COP-HF 2.3: Harnessing the potential of remote sensing for nature-based solutions for climate and biodiversity

Description:

Earth observation has great potential for monitoring the state of and changes in ecosystems and for improving forecasting. The targeted use of Earth observation data can simplify and optimize environmental and nature conservation monitoring at Federal, federal state and municipal levels. The aim is to make better use of this potential within the framework of the BMUV's Action Plan on Nature-based Solutions for Climate and Biodiversity. The key here is to make Earth observation data easier to access and use for nature-based solutions for climate and biodiversity. To do this, it is necessary to provide low-threshold access to Earth observation data and tools and to conduct training.

Objective:

- Development and operational provision of a platform with a modular toolbox for efficient environmental monitoring for authorities at Federal, federal state and municipal levels in environmental and nature conservation, as well as for stakeholders involved in the Action Plan on Nature-based Solutions for Climate and Biodiversity.

Contribution to the success factors:

Measure COP-HF 2.4: Continuing the ongoing participation in the EU's 'Destination Earth (DestinE)' initiative

Description:

Digital twins of the Earth offer new potential to develop impact scenarios for political or economic measures. Earth observation makes an indispensable contribution to this, and digital twins can enormously expand the applications of Earth observation. DestinE is a flagship initiative of the European Commission that aims to develop a high-precision digital model of the Earth system as a digital twin by 2030. Numerous research institutes, ECMWF, EUMETSAT, ESA and various authorities are directly contributing their expertise to help build the DestinE information system. In addition, the Federal Government is funding Earth system modelling and further digital twin development projects for various areas of application that expand the basis for DestinE.

The Federal Government, under the lead responsibility of the BMDV, is combining user interests, incorporating them into the evolution of the DestinE programme and advocating funding opportunities for innovative developments.

Objectives:

- DestinE supports users in developing and implementing policy measures by generating decision-relevant information. It links and enhances the use of Earth system science and Earth observation infrastructures, such as EUMETSAT and Copernicus, as well as high-performance computing, thereby adding socio-economic value.
- DestinE and other digital twins, such as the European Digital Twin of the Ocean, and those with a municipal focus, are continuously developed in line with user needs with the involvement of the relevant national stakeholders and complementary initiatives, as well as pertinent research and development programmes.

Contribution to the success factors:

Action area ‘Communication and networking’

On the whole, there already is a wide range of Copernicus data, services and products. Copernicus is already in use in many areas, so that both awareness of Copernicus and Earth observation data and the knowledge of possible applications are continuously growing. Nevertheless, there is still room to improve the knowledge and awareness of some potential and some existing user groups – particularly with regard to actual use cases, existing applications, data and service infrastructures, and innovations in Copernicus. There is still untapped or developable application potential, for example at the municipal and regional levels (e.g. in connection with planning activities, public services obligations or with regard to the energy transition), in agriculture and forestry, in cultural heritage protection, in climate action and environmental protection, for ESG reporting obligations[22] or in development cooperation.

Accordingly, this action area aims to combine information on Copernicus more effectively and to make it available in a manner that is better aligned with user needs. We also want to promote dialogue between value-added service providers and (potential) users by expanding and perpetuating existing network structures and information services.

In addition, enhancing networking between the different federal levels, between the Federation, federal states and municipalities, is an important factor for sharing experience on possible applications, support services and data access. It should therefore be further promoted. In light of these aspects, the following measures are planned for the Copernicus programme in the ‘Communication and networking’ action area:

Measure COP-HF 3.1: Expansion of the German Copernicus website into a central information platform for Earth observation

Description:
To further boost the use of Copernicus in Germany, it is necessary to provide coherent, constantly updated and application-oriented information – both about the programme and about possible uses and sample applications. Accordingly, we want to expand the existing German website of the Copernicus programme (d-copernicus.de) to a central information platform that presents specific sample applications and services, categorized by area of application. In this way, the platform will emphasize the added value of Earth observation data for users. The website also is to provide an overview of other Earth observation missions, meteorological missions

[22] Environmental, Social and Governance

and complementary national geodata in order to make it easier to combine Copernicus data with other relevant data.

Objective:

- Users are informed about services and sample applications for Copernicus and other Earth observation programmes and utilize the corresponding data and products for their respective use cases.

Contribution to the success factors:

Measure COP-HF 3.2: Establishing, expanding and perpetuating network structures for Copernicus users

Description:

With the advisory centres of the coordinators and experts, as well as the Copernicus network offices for municipal, transport and soil, there are already appropriate points of contact that are geared towards specific areas of application and that network users with each other and with service and product developers. Building on this, we want to strengthen the technical work within the framework of the existing network offices on the one hand, and establish further network offices and make available experts for new areas of application on the other hand. Furthermore, formats for cooperation and the exchange between authorities and companies, on the one hand, and universities and research institutions, on the other hand, are to be supported, among other things to attract young scientists to work with Copernicus.

Objectives:

- Existing and potential Copernicus users are in regular contact with each other within their areas of application, share knowledge and develop solutions for relevant applications.
- Expert users are involved and their needs are identified, which helps with the continuous evolution and user orientation of the Copernicus programme.
- Knowledge and solutions are successfully mainstreamed in authorities through networking with industry and research institutions in Earth observation.

Contribution to the success factors:

Measure COP-HF 3.3: Supporting the Group on Earth Observations (GEO) and Germany's development policy goals

Description:

Information from Earth observation supports the goals of major multilateral agreements, such as the United Nations Sustainable Development Goals and the Paris Agreement on climate change. Achieving these together is one of Germany's development policy goals. Fulfilling the associated reporting requirements and verifying the effectiveness of measures, requires the best possible international coordination of Earth observation. As an intergovernmental organization in which more than 100 governments and an equal number of international organizations have joined forces, GEO provides a suitable framework

for this. We as the Federal Government support GEO particularly in the context of various 'flagship initiatives', which are characterized by the fact that they address global problems and monitoring tasks in close alignment with UN initiatives and conventions. We want to continue and further strengthen this support in line with Germany's goals in the future, too.

Objectives:

- Copernicus and other European and national Earth observation capacities make a visible and effective contribution to solving global societal challenges and achieving the goals of multilateral agreements.
- Achievement of Germany's goals is facilitated, and German expertise is used in international cooperation.

Contribution to the success factors:

Action area 'Resources and expertise'

Processing and analysing complex satellite images and large volumes of often heterogeneous data requires not only sufficient time, an appropriate budget and suitable technical infrastructure, but also specific data science and geospatial expertise. However, the public sector in particular often lacks the appropriate resources, especially skilled personnel and time, to deal with Copernicus data and the possibilities of satellite-based remote sensing and to integrate them into workflows and existing procedures ('last mile').

The focus of this action area is therefore, on the one hand, the provision of competent advice to public administration staff and, on the other hand, the establishment and development of expertise in the field of Earth observation – particularly for the public sector – to make it possible to use Copernicus data, services and products in a way that adds value. In doing so, we also want to strengthen the exchange and synergies with the scientific community and the private sector. In addition, this action area aims to expand advisory and other services provided to users in the public administration in order to address challenges related to limited time, financial, technical and human resources. We also want to strengthen the use of innovative tools and technologies, such as artificial intelligence, and promote the use of Copernicus data and services in the development of data-driven business models. In light of these aspects, the following measures are planned for the Copernicus programme in the 'Resources and expertise' action area:

Measure COP-HF 4.1: Expanding training and continuing education programmes on satellite-based Earth observation for public administration

Description:
Technical expertise and knowledge are key prerequisites to further boost the use of Copernicus in Germany. We therefore want to start by analysing the specific needs for capacity building and then match them with existing training opportunities in a more targeted manner. We also want to identify potential gaps in the public sector's range of training and continuing education programmes, as well as determine and implement options to meet these needs with the help of public, academic or private-sector providers. In doing so, a focus should be placed on the use of freely available, often already state-funded, open-source tools and products. To develop expertise and train specialized personnel, we want to strengthen cooperation with national universities and research institutions in addition to the existing Copernicus expert coordination.

Objectives:
- Specialist personnel is available in the public administration departments, where they are needed to use satellite-based Earth observation.
- This personnel is familiar with the technical possibilities and limitations of satellite remote sensing and with the links to the relevant directives and monitoring measures.

Contribution to the success factors:

Measure COP-HF 4.2: Establishing and expanding centralized services for the provision of advice, data acquisition and data analysis for public administration

Description:
Existing advisory and other services, such as the Copernicus expert coordination and the Federal Service Point of Remote Sensing at the BKG, have already shown how a lack of resources in public administration can be countered effectively. On the one hand, this can be done by providing advice on the uses and sources of satellite data and complementary technical and open data. On the other hand, it can be done by acquiring commercial satellite data for the Federation, providing training to and networking stakeholders; furthermore, it can be achieved by developing individual products and solutions using established and innovative remote sensing methods. We therefore want to establish and expand appropriate advisory and other service structures for public users in inter-authority and interdisciplinary bodies, such as the Copernicus expert coordination and the SKD at the BKG. In doing so, opening up the advisory, application development and commercial data procurement services to all federal levels, in particular the federal states, should also be considered. Furthermore, advisory and cooperation opportunities for the introduction of innovative Earth observation methods into everyday administrative practice are to be continued via framework agreements such as the IF-Bund.[23]

[23] Innovative remote sensing for the Federal administration (IF-Bund) (https://www.imagi.de/Webs/IMAGI/DE/themen-und-projekte/rahmenvertrag-if-bund/rahmenvertrag-if-bund-node.html – in German only)

Objectives:

- Public authority users receive expert advice, use specific services, harness the potential of freely available data and tools, cooperate in the further development and access additional commercial data if needed.
- Services based on remote sensing are evolved, used and accepted as a suitable alternative to conventional services.

Contribution to the success factors:

Measure COP-HF 4.3: Expanding instruments to promote innovation based on Copernicus

Description:

In particular in areas of application where satellite-based remote sensing, including the Copernicus programme, is still used rarely, support for innovative ideas is needed to harness application potential and consolidate it in the long term. Furthermore, the use of modern tools and methods, such as AI and digital twins, can simplify and expand the use of data from the Copernicus programme and allow new areas of application to be opened up. We therefore want to establish and expand instruments that promote innovative products, business models and data processing methods based on the services provided by the Copernicus programme. In addition, the development of innovative applications is to be more firmly established in existing funding guidelines. Synergies and opportunities for cooperation with existing innovation funding are to be discussed, without limitation to specific topics. In addition, public authority users receive support under the 'National Copernicus Integration Measure' funding programme and projects from the IF-Bund framework agreement to translate already developed resources and innovative methods into 'robust' and user-oriented applications for administrative practice. Moreover, the development of new application methods and business models in Earth observation is funded under the 'Space Programme for Innovation and International Cooperation – Research and Development Projects'.

Objectives:

- Developers generate novel, robust methods and applications, also based on suitable funding opportunities.
- End users benefit from suitable funding opportunities to sustainably operationalize robust methods, including subsequent use effects.

Contribution to the success factors:

Action area ‘Regulatory framework’

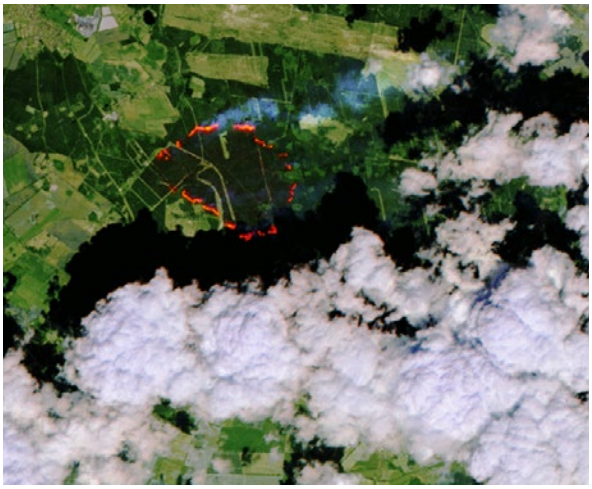
Explicitly enshrining the option of using satellite-based Earth observation in relevant directives and legislation can boost the use of Copernicus data and services by creating a secure legal framework for data use by stakeholders. This is particularly important in view of the increasing reporting requirements resulting from European and national legislation, for example in agriculture and forestry, nature conservation and climate action, water management, etc. Satellite-based Earth observation provides tools for the objective collection of comprehensive geospatial information and limiting the effort required for monitoring and reporting. In light of these aspects, the following measure is planned for the Copernicus programme in the ‘Regulatory framework’ action area:

Measure COP-HF 5.1: Creating a suitable regulatory framework for the use of Copernicus data, services and products for governance action

Description:
Selected national regulatory frameworks with links to potential areas of application for satellite-based Earth observation are to be examined with regard to the (explicitly enshrined) options for using the corresponding data, services and products and, where appropriate and possible, adapted in interaction with existing monitoring methods. In addition, the Federal Government wants to work towards the inclusion of corresponding usage authorizations in relevant EU Directives and support the implementation in Germany.

Objective:
- Public administration employees use data and services from the Copernicus programme and derived products in a reliable and legally compliant manner to fulfil their tasks.

Contribution to the success factors:



The Copernicus emergency management service supports civil protection authorities and emergency services, e.g. in acute emergency situations caused by floods, storms, earthquakes, forest fires, landslides or humanitarian crises. This Sentinel-2 image shows a wildfire that broke out on a military training area in Lübtheen in northern Germany in June 2019.

The European Galileo programme

4.1 Programme and stakeholders

Galileo is a Global Navigation Satellite System (GNSS) and a European Commission programme.

The programme comprises three segments: the space segment, the ground segment and the user segment. The space segment of Galileo consists of a constellation of satellites in medium Earth orbit that transmit position and time signals. The ground segment includes technical systems that control the operation of the satellites. They generate the navigation information that they transmit via Galileo signals. The user segment is made up of all receivers that are compatible with Galileo.

Galileo is under European civilian control and provides autonomous navigation and positioning services, but is also interoperable with GPS,[24] GLONASS[25] and Beidou.[26] The first services of the Galileo programme have been in operation since December 2016. For navigation, a distinction is made between the Galileo Open Service (OS) as a 'basic service' and the various 'special services'. Overall, the Galileo system will offer the following services (state of planning as at: 08/2024):

Open Service (OS), the open and free service

Open Service Navigation Message Authentication (OS-NMA), which complements the OS by providing authenticated data

High Accuracy Service (HAS)

Search and Rescue Service (SAR) – the European contribution to the International Satellite System for Search and Rescue COSPAS-SARSAT

Emergency Warning Satellite Service (EWSS) – for the satellite-based transmission of emergency warnings to the population

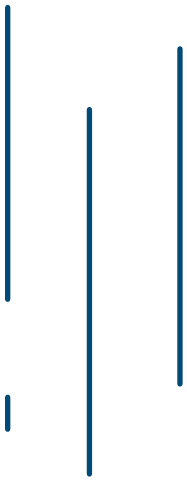
Public Regulated Service (PRS) – the specially protected and encrypted navigation signal restricted to state-authorized users

[24] GPS: NAVSTAR Global Positioning System, operated by the US military.
[25] GLONASS: Global Navigation Satellite System, operated by the Russian military.
[26] Beidou: Global Navigation Satellite System, operated by the People's Republic of China.

Galileo's special services (HAS, EWSS, OS-NMA, SAR), which can be used without explicit authorization, are being developed in line with needs or are already in operational use. For the Galileo PRS as a secured GNSS service, the first PRS receivers have already been developed and are available. The PRS service will reach full operational capability in 2025.

Each EU Member State that wishes to use the PRS is obliged to set up a PRS authority. The national PRS authorities are responsible for ensuring security in connection with the development and use of the Galileo PRS in the respective Member State. They are also responsible for user management and support.

When end users use Galileo OS, it is usually not in a targeted manner and therefore not based on specific properties or unique features of the Galileo system. Rather, the Galileo OS is almost always used alongside other GNSS, such as NAVSTAR GPS, GLONASS or the Chinese Beidou system. When used in such a multi-GNSS environment, the signals are combined in the receiver, allowing for a sufficiently precise positioning for many applications – often without users being aware of the fact that their applications use GNSS services or specific GNSS systems as a rule.



Sample application: Time synchronization for controlling gas turbines in the energy sector

Challenge: Energy grids are key critical infrastructure and a kind of lifeblood for our society. For the smooth transfer of energy, various networks, as well as the systems and devices in these networks, must be precisely coordinated with each other in terms of grid frequency in order to avoid grid disruptions.

Added value of Galileo signals: As a European satellite navigation system that is available worldwide, Galileo provides extremely precise time reference signals. These are currently used by power plant and grid operators in Germany, for example, to automatically synchronize the speed control of gas turbines with the grid frequency of the energy grid when generating electricity. The Galileo signal is available internationally and is provided self-sufficiently by the European Union.

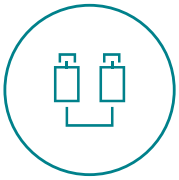
Atomic clocks play a crucial role in the satellite navigation system, as they allow for precise timing and positioning.

The European Commission has overall responsibility for the Galileo programme and provides the resources from its EU budget.

The Commission has delegated operational management of the Galileo programme to EUSPA, the European Union Agency for the Space Programme.[27] EUSPA is responsible for the ground, space and user segments of the Galileo programme and ensures that the Galileo services are provided as planned. The European Commission gives ESA the mandate to technically evolve the system. ESA is therefore responsible for the modernization of the satellites themselves.

4.2 Action areas and measures

The overarching action areas described in section 2.2 can be specified for the Galileo services. The action areas and the measures envisaged in each case are described below. They are summarized in the User Uptake Strategy of the Federal Government and represent the strategic focus of the responsible government departments.



Action area 'Infrastructure, availability and access'

Ensuring easy, comprehensive and free access to Galileo services is an important basic prerequisite for making the services widely usable. As the Federal Government, we are therefore working to ensure that receivers for Galileo's special services are available for all relevant application scenarios and in line with user needs, and that they are suitable for the respective use cases. Furthermore, the ways to harness synergies between different public navigation services, including the (terrestrial) GEPOS/SAPOS correction service,[28] are being examined and better leveraged. In light of these aspects, the following measures are planned for the Galileo programme in the 'Infrastructure, availability and access' action area:

[27] The EU Space Programme includes the following components: Copernicus, European Geostationary Navigational Overlay Service (EGNOS), Galileo, Secure Satellite Communication (Secure SATCOM) and Space Situational Awareness (SSA).

[28] The satellite positioning service of the Federation (GEPOS) and the German State Surveying Agency (SAPOS) is a satellite reference service of the Federation and the federal states that provides correction data in Germany to enable more precise positioning.

Measure GAL-HF 1.1: Improving the integration of public navigation services

Description:
Galileo services do not exist in isolation, but are part of an ecosystem of various national and international and also terrestrial navigation services. The evolution and application-specific use of the services should therefore not be regarded individually, but ideally as an integrated network to leverage synergies.

In this context, an interministerial exchange is being initiated by the BMI and BMDV, for example via the Interministerial Committee for Geoinformation (IMAGI). The range of services provided by the HAS is harmonized with the range of services provided by the satellite positioning service (GEPOS/SAPOS), for example.

Objective:
- Publicly provided navigation services are aligned with each other in terms of their use.

Contribution to the success factors:[29]

Measure GAL-HF 1.2: Promoting the availability of receivers for Galileo's special services

Description:
Integrating Galileo's special services into existing applications, especially certified applications, such as for (civil) aviation, requires considerable effort in some cases. These 'set-up costs' have so far led to a low demand for receivers for Galileo's special services. This is compounded by the fact that, at the same time, the availability of appropriate receivers is low. As the Federal Government, we are taking action by contributing to the availability of receivers and thus supporting the introduction of Galileo's special services.

Objectives:
- Users, especially those of certified applications, have access to a sufficient number of receivers that are suitable for using Galileo's special services.
- Due to the broad availability of PRS receivers that are easy to operate and suitable for use, the Galileo PRS is employed in line with user needs, harnessing the full potential of the PRS.

Contribution to the success factors:

[29] Legend for 'Contribution to the success factors'; greyed-out symbols indicate that no specific contribution is made.

Action area ‘Demand-driven data and services’

The demand-driven development of Galileo services is a key factor in increasing the intensity and quality of use. Users need in particular services that are accurate, available and immune to interference. This action area therefore aims to align the provision of information with user needs. To this end, we are focusing on identifying user needs more consistently and, based on this, aligning existing and future Galileo services with these needs. In light of these aspects, the following measures are planned for the Galileo programme in the ‘Demand-driven data and services’ action area:

Measure GAL-HF 2.1: User-focused evolution of Galileo’s services

Description:
Many different stakeholders are involved in shaping and evolving the Galileo services. In order to continuously improve the services, the Federal Government is working at European level to evolve the existing services and also to introduce a requirements management system to collect and process information on user requirements. The requirements management system records, in a targeted manner, information on the needs of groups of potential users, some of which are heterogeneous, and incorporates this information in the development of services.

Objective:
- Galileo services are tailored to user requirements, since their needs have already been taken into account at an early stage in the planning of new and the evolution of existing services.

Contribution to the success factors:

Measure GAL-HF 2.2: Expanding the range of reference data and technical documentation provided for publicly available Galileo special services

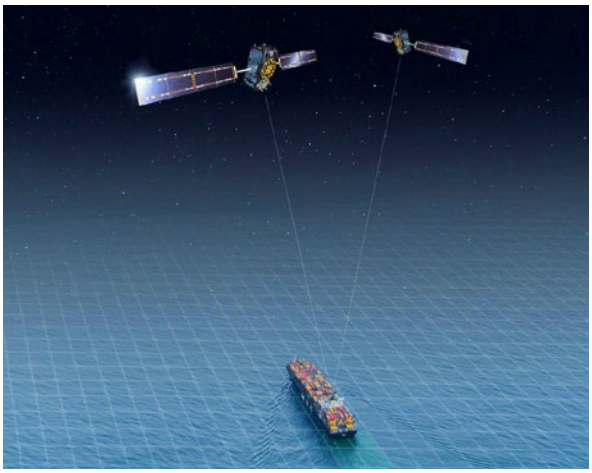
Description:
The use of Galileo’s special services requires comprehensive documentation of the technical reference data during the application phase. In addition, continuous access to current performance parameters of the Galileo system is a prerequisite for users to validate and guarantee the performance of their respective applications.

In addition to a requirements analysis of the necessary reference data, a central archive that provides the relevant data and documentation is therefore being created and promoted.

Objectives:

- Users with special requirements in terms of positioning accuracy retrieve reference information on the performance parameters of open Galileo services in real time.
- Users can retrieve the latest technical specifications of openly available Galileo services in their entirety and from a central location.

Contribution to the success factors:



With effective navigation, ships can plan the best routes to save time and fuel. This is especially important on long voyages across oceans, where many factors such as currents and weather conditions have to be taken into account.

Action area ‘Communication and networking’

There is a key vehicle for increasing the use of Galileo: improving knowledge of the various special services, and, building on this, improving awareness of the wide range of possible application scenarios. With that in mind, this action area focuses on the targeted networking of relevant user groups and optimizing the provision of information and communication on Galileo. To this end, we will combine existing information channels and address potential users in an even more targeted and proactive manner. In light of these aspects, the following measure is planned for the Galileo programme in the ‘Communication and networking’ action area:

Measure GAL-HF 3.1: Improving the information provided to potential users on the capabilities and potential applications of the Galileo services

Description:

Clear and tailored communication about the capabilities of the various Galileo services and successful applications plays an important role in increasing demand for the services. This will be achieved in particular by providing an overview of sample applications of Galileo services that have already been successfully established (catalogue of applications). Potential users can thus discover potential applications and benefit from lessons learned in successful applications.

The BMDV has lead responsibility for the centralized preparation and updating of the catalogue of applications. Its provision as well as activities targeted at user groups with a high potential added value (multipliers) will increase interest in the Galileo services.

Objective:

- Potential users are aware of the existence and significance of Galileo's special services relevant for them and use the information on the services as well as relevant use cases in a targeted manner to meet their needs.

Contribution to the success factors:

Action area 'Resources and expertise'

In order to use satellite-based navigation services, organizations must have the appropriate skills and sufficient resources. For many (potential) users, appropriate advisory services and access to funding make it easier or even possible in the first place to implement the relevant Galileo services. Therefore, existing support options, such as the transfer programme of the Galileo Competence Center at the German Aerospace Center (DLR), are also being evolved. In light of these aspects, the following measures are planned for the Galileo programme in the 'Resources and expertise' action area:

Galileo is ideal for applications that require precise location data, such as mapping, geodesy and land surveying.

Measure GAL-HF 4.1: Increasing advisory capacities for potential users of Galileo's special services

Description:
In order to boost the awareness and enhance the adoption of Galileo's special services among potential users, we as the Federal Government are increasingly addressing the existing need for technical, legal and organizational advice with the provision of public services. We do this by specifically tailoring existing advisory services to users and creating new technical and organizational advisory services that stakeholders need to build their own expertise. It should be noted that availability may be limited as a result of natural influences or deliberately induced disruptions or limited fail-safe capabilities of space-based infrastructures. A PRS contact point with expertise in the provision of technical, legal and organizational advice for authorized PRS user groups is being set up for the Galileo PRS within the framework of the existing PRS authority.

Objective:
- Users know how to use Galileo's special services for their purposes and their organization and how to create the necessary conditions for this.

Contribution to the success factors:

Measure GAL-HF 4.2: Synchronizing and evolving funding opportunities for the use of Galileo's special services in public administration

Description:
There are already funding programmes to support the introduction and innovative piloting of applications using Galileo services. Based on that, we are making an overview of existing programmes available to the public, evolving the existing funding programmes and aligning them with each other.

Objectives:
- Funding programmes strengthen the budgetary and personnel capacity to use Galileo's special services for the key use cases in the respective remits of the potential users.
- Public authorities and other potential users are optimally informed about tailored funding opportunities.

Contribution to the success factors:

Action area 'Regulatory framework'

This action area aims to increase the resilience of the Galileo services and applications and to expand the range of possible uses of the services by means of an appropriate regulatory framework. In particular, being able to use GNSS services securely and reliably is an essential prerequisite for security-sensitive use scenarios. In light of these aspects, the following measures are planned for the Galileo programme in the 'Regulatory framework' action area:

Measure GAL-HF 5.1: Enhancing resilience and ensuring availability of Galileo services in Germany and Europe

Description:

A disruption to availability or, worse, the failure of a service can have existential consequences for users, who depend on the detection, investigation and, where possible, prevention by government agencies of natural or artificial disruptions – especially those caused by 'spoofing' or 'jamming'. Particularly for commercial and safety-critical purposes, liability issues play a role, i.e. when it comes to determining who is liable for or will take responsibility for the impact of failures. The legal basis and framework conditions should therefore be reviewed and improved, if possible. The space security aspect will be addressed in the Federal Government's Space Security Strategy, which is currently being drawn up, in order to permit the protection of space services such as GNSS signals in the future. The 'Global Geodetic Supply Chain' is another prerequisite for Galileo GNSS operation. The entire supply chain considered here should therefore be secured.

Objectives:

- Users can, where feasible, use both the Galileo OS and Galileo's special services without signal disruptions and distortions.
- Users are informed about disruptions and distortions of the signals from the Galileo system.
- Security-sensitive users build infrastructure and business models based on Galileo and European complementary GNSS services both in critical and non-critical infrastructure.

Contribution to the success factors:

Measure GAL-HF 5.2: Evolving the regulatory framework to boost the adoption of Galileo services in security and critical infrastructure

Description:
The Galileo PRS is currently the only GNSS service under civil control that is to be made available not only to military users but also to the civil sector (authorities and organizations with security and safety tasks, critical infrastructure).

In some of these areas, the use of the Galileo PRS as a highly secure European GNSS alternative would be useful and both technically and legally feasible. In some cases, there is little incentive for its adoption due to the effort and cost involved. The examination and influencing of regulatory changes for authorized public authorities and private users can improve the framework for a future (possibly also priority) use of the PRS.

Objectives:
- Institutions in security-sensitive sectors know whether they are entitled to use the Galileo PRS or are even required to prioritize its use.
- Authorized public bodies and private stakeholders operating critical infrastructure use the PRS across the board in security-critical applications in timing and positioning.

Contribution to the success factors:

Measure GAL-HF 5.3: Working towards European rules to ensure that the Galileo OS can be used self-sufficiently in Germany and Europe

Description:
In order to achieve the greatest possible benefit and eliminate potential dependencies on established GNSS, we as the Federal Government will work at the European level to establish Galileo as a further reliable standard for receivers.

Furthermore, we advocate making Galileo mandatory and also providing for its use as a self-sufficient alternative to NAVSTAR GPS in civilian application areas such as in aviation and shipping.

Objectives:
- Many GNSS users from all application areas rely on the Galileo Open Service (OS), which is already operational. The Galileo OS thus delivers independent usability, reliability and resilience of an application, even if other GNSS services are deactivated or disrupted.

Beitrag zu den Erfolgsfaktoren:

EUMETSAT meteorological programmes

5.1 Programme and stakeholders

The European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) is an intergovernmental organization counting 30 European member states. It is a cornerstone of joint European activities in weather monitoring, climate observation and environmental monitoring.

The Federal Republic of Germany was one of the founding members in 1986 and currently bears the largest funding share of the organization. EUMETSAT is responsible for operating the European weather satellites (especially Meteosat, EPS, Jason/Sentinel-6)[30] as well as for processing and sharing the resulting data and products. With its eight Satellite Application Facilities (SAFs), EUMETSAT adds further value. While management of the SAFs is under the responsibility of the national meteorological services of the EUMETSAT member states, the facilities themselves are run by international consortia. The SAFs provide users with operational data and software products. Each SAF is dedicated to one of the following areas of application:

- Atmospheric Composition Monitoring (AC SAF): Develops and provides products to monitor atmospheric composition, including ozone, trace gases and aerosols
- Climate Monitoring (CM SAF): Generates and provides long-term climate datasets
- Land Surface Analysis (LSA SAF): Develops and provides products to analyse the Earth's surface, including vegetation and wildfires
- Ocean and Sea Ice (OSI SAF): Develops and provides products to monitor ocean and sea ice conditions
- Numerical Weather Prediction (NWP SAF): Develops and provides software for improved utilization of satellite data in numerical weather prediction models
- Radio Occultation Meteorology (ROM SAF): Profiles the vertical structure of the atmosphere by processing radio occultation data for weather and climate applications
- Nowcasting and Very Short Range Forecasting (NWC SAF): Develops and provides software to support short-term weather forecasts
- Operational Hydrology and Water Management (H SAF): Develops and provides short- and long-term products to support hydrology and water management

[30] Meteosat is the fleet of geostationary weather satellites operated by EUMETSAT. The derived parameters include cloud cover and cloud type, Earth and cloud surface temperatures as well as humidity parameters. To complement the Meteosat data, the EUMETSAT Polar System (EPS) series includes polar-orbiting satellites (Metop, in particular). Their advantage over geostationary satellites is that they offer global coverage, including the polar regions, and a higher resolution. Sentinel-6 data is used to measure sea levels, delivering crucial data for climate research.

In addition, the Integrated Greenhouse Gas Monitoring System is used in Germany to combine satellite data with model data and ground-based Earth observation data related to climate and environment. It thereby provides information for current political questions, for instance in respect to the transformation of the energy system.

EUMETSAT provides a central satellite-based data source for the models and services (weather observation and forecasting) of the German Meteorological Service (DWD), the European Centre for Medium-Range Weather Forecasts (ECMWF) and private weather service providers. In order to make the data accessible to specific target groups, EUMETSAT operates various cloud platforms.

ECMWF is a key player in the processing of weather-related data, especially from weather satellites. As an independent European organization, the Centre provides various global forecasts to national weather services, private service providers and researchers. It is also responsible for two of the EU's Copernicus services (see chapter 3.1).

At national level, the DWD is the central institution providing weather- and climate-related data and products as well as forecasts for disaster control. In addition to the EUMETSAT satellite data, the DWD also draws on other internationally available satellite data and products as well as on broad national and international ground-based observation networks.

The DWD, ECMWF and multiple private weather service providers offer companies, private end users and public stakeholders in Germany many weather and climate products and forecasts. End users do not reap the benefits of the European meteorological satellite infrastructure directly from the raw data, but from the weather and climate products and forecasts derived from it.

Outside of the primary value chain, the World Meteorological Organization (WMO) is responsible for standardization initiatives for weather-related data and products as well as for the global international exchange of satellite data, from which German applications also benefit greatly. This specialized agency of the United Nations, which has 193 member states, promotes international cooperation through various other activities.

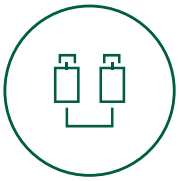
Precise weather data ensures safer skies for aviation.

Sample application: Integrating near real-time satellite data in flight operations

Challenge: Safe and efficient flight operations largely depend on current weather conditions. Although a detailed weather briefing is a mandatory standard procedure for airlines before take-off, the weather situation can change dynamically during a flight. While weather radars on aircraft can detect dangerous situations (such as thunderstorms on the planned route), the lack of spatial detail often means that the pilot has to fly a considerable detour around the hazard.

Added value of EUMETSAT data: Integration of weather models (especially storm maps) allows pilots to better assess dangerous situations, enabling more strategic flight operations. The comprehensive and high-frequency measurements of the EUMETSAT satellites play an essential role in generating near real-time meteorological information for aviation.

5.2 Action areas and measures



Action area ‘Infrastructure, availability and access’

As an operational organization managed by its users, EUMETSAT serves the needs of its member states. The member states co-finance the EUMETSAT programmes and activities. For this reason, this action area focuses on representing the interests and needs of German users in the EUMETSAT Council. A key aspect of this is the continuous development of EUMETSAT’s meteorological programmes in line with said needs, including the specifications for new missions. Another aim is to ensure the availability and usability of data, services and products from the programmes. As central delivery channels for weather-related data and products, the platforms of EUMETSAT, ECMWF and the DWD play an essential role in supplying value-added service providers and end users throughout the weather and climate ecosystem. The existing structures will be expanded and perpetuated within the scope of this Strategy. This is to ensure low-threshold, modern and high-performance technical access to EUMETSAT satellite data and derived weather and climate products in the future, as well. These low technical barriers are an essential prerequisite for developing innovative value-added services and AI applications. Another important aspect in this context is the general technological capacity to generate and process climate- and weather-related data. In light of these considerations, the following measures are planned for EUMETSAT’s meteorological programmes in the ‘Infrastructure, availability and access’ action area:

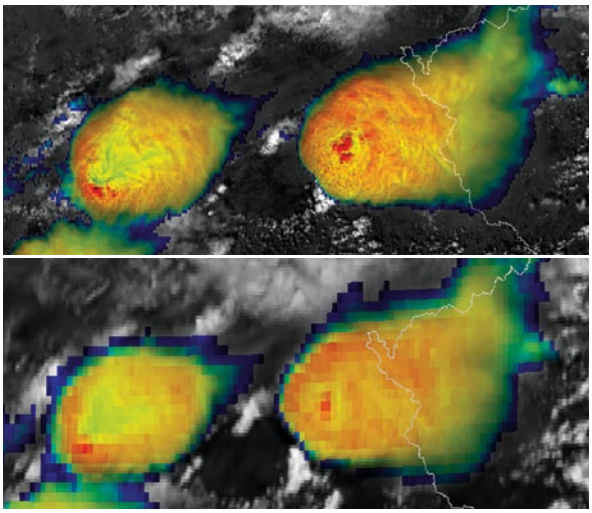
Measure EUM-HF 1.1: Ensuring the continuity and user-driven development of the EUMETSAT meteorological programmes

Description:
It is essential to continuously develop the satellite programmes. This will enable us to further increase the national utilization of data from the EUMETSAT meteorological programmes and adequately serve the growing needs and capacities of users. Existing processes for systematically collecting data on the interests of German users are being continuously advanced and expanded, for instance with regard to the future M4G and EPS-TG programmes. The Federal Government will continue to proactively address these needs in the relevant EUMETSAT committees. In doing so, we are contributing both to the content of the EUMETSAT meteorological programmes and to their long-term technical development.

Objectives:

- German user interests are consistently taken into account in the development of future EUMETSAT meteorological programmes.
- Users can rely on the long-term and dependable operation of the satellite programmes and thus have planning security.

Contribution to the success factors[31]:



Convective cloud cover over Central Europe as seen in images from the Meteosat Second Generation (bottom) compared to images from the new high-resolution Meteosat Third Generation mission (top). The Meteosat Third Generation images give a better view of the cloud structure and, as a result, allow more accurate estimates of potential extreme weather developments.

Measure EUM-HF 1.2: Modernizing the IT infrastructure to process meteorological data

Description:

Generating and processing weather- and climate-related data requires significant computing resources. As technical possibilities constantly evolve, the demands placed on the IT infrastructure also grow. By modernizing the systems and creating an agile and more innovation-friendly environment, we aim to increase the technological performance and interoperability of EUMETSAT, ECMWF and the DWD, in particular. We intend to achieve this by integrating cloud systems, for instance.

Objective:

- Agile and innovation-friendly IT infrastructure at national and European levels is the basis for adding further value at the hands of public and commercial users.

Contribution to the success factors:

[31] Legend for contribution to the success factors; greyed-out symbols indicate that no specific contribution is made.

Measure EUM-HF 1.3: Demand-driven development of user interfaces to retrieve weather- and climate-related data

Description:
The various technological retrieval structures for weather- and climate-related data are complex. For new market participants in particular, they can require considerable efforts to obtain the data and thus represent a barrier to enhanced utilization. By developing the interfaces in line with user needs, we want to ensure that the retrieval structures of the organizations in question are always efficient and meet modern standards (e.g. with regard to automated retrieval options or user-friendliness). Structured identification of user needs and regular dialogue between the institutions are to form the basis for a continuous improvement process. Furthermore, we plan to examine whether select EUMETSAT and DWD data can also be made available on CODE-DE, the national Copernicus platform, via an interface in order to expand the user group with minimal effort.

Objectives:
- Modern infrastructure and administrative processes minimize the effort involved in obtaining weather- and climate-related data.
- New market participants also have easy access to the data, which lays the foundation for continuously adding value.

Contribution to the success factors:

Action area ‘Demand-driven data and services’

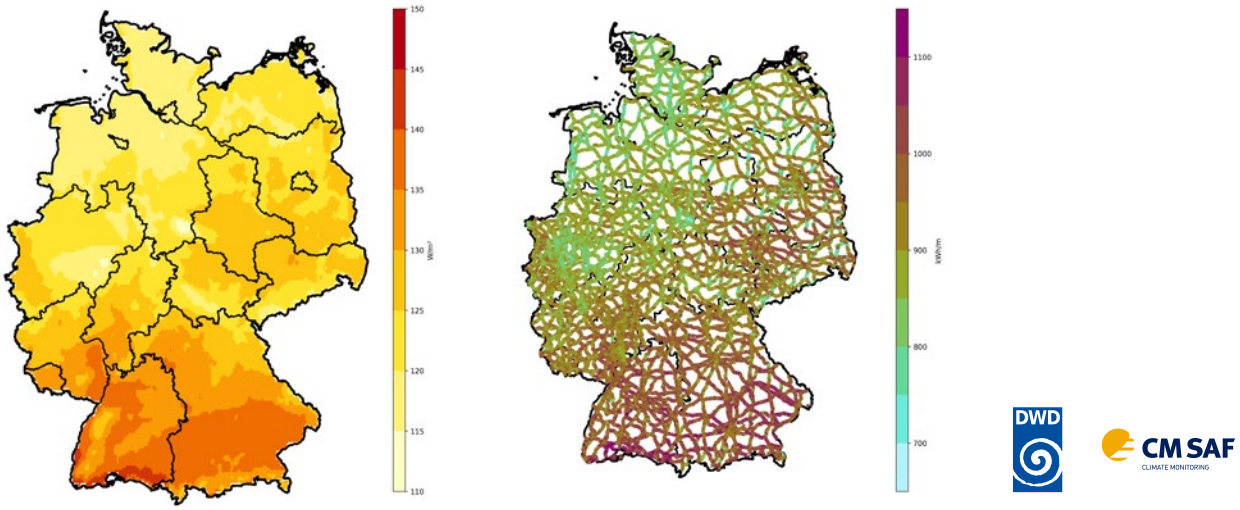
In order to increase the utilization of weather-related data across the board, it is essential that the range of products available is tailored as closely as possible to the needs of users. Within this action area, efforts will be made to develop the product range for current and new user groups as best possible and to adopt new and innovative methods. In meteorology, for example, there is great potential when it comes to employing machine learning, especially for automated assimilation of various data sources or the expansion of analytical capabilities. This allows existing weather forecasts to be improved in terms of resolution and quality. With this Strategy, we want to ensure that there are more potential use cases for publicly generated data in existing and new areas of application. The basis for this are adjustments in terms of scale, depth of processing and interoperability of the products and, in particular, perpetuating standardization initiatives. This should also boost the resulting value creation. In light of these aspects, the following measures are planned for EUMETSAT’s meteorological programmes in the ‘Demand-driven data and services’ action area:

Measure EUM-HF 2.1: Maintaining and expanding the available range of weather- and climate-related data and products

Description:
Improving temporal and spatial resolution is a key source of potential for boosting utilization of weather- and climate-related data and products. New data obtained on additional instruments offers further potential, for example with further measurement frequencies, new measurement methods and with the future increase in the number of satellites, both in the EUMETSAT and Copernicus programmes. The prerequisite for leveraging this potential is the continuous development of technological possibilities (e.g. in the context of AI modelling), which simultaneously creates the need for additional data. Data that already exists but is not fully accessible to the public (e.g. more detailed forecast model parameters or archive data) is of particular interest in this context. For this reason, we want to make it possible to continuously expand the available range of products and services offered, including open data sources, while taking technical, legal and functional restrictions into account. In addition, initiatives for the scientific development of the public product range are to be continued, strengthened and better combined, for example through the EUMETSAT SAF programme.

Objectives:
- Sustainability and expansion of the EUMETSAT SAF network as a central user-focused element in the evaluation and provision of satellite data and products.
- Value-added service providers and users have access to the broadest possible database to (further) develop weather-related applications.
- Continuous improvement of the quality of the data and products increases the value added by using them and opens up new areas of application.

Contribution to the success factors:



Map of solar radiation from satellite data (left) and in the application to determine the possible energy generation if all noise barriers along federal roads were equipped with photovoltaic systems (right).

Measure EUM-HF 2.2: Perpetuating standardization initiatives and continuously developing formats for weather- and climate-related data

Description:
Standardized data formats are an important basis for developing new use cases and products. Especially AI-based applications benefit significantly from such formats. As part of this measure, we want to redouble our efforts in enhancing the use and development of (international) standards. This includes developing and improving common formats for weather- and climate-related data (netCDF, BUFR) as well as initiatives to standardize accompanying metadata and quality information.

Objective:
- Satellite data and derived products (e.g. weather-related data from the DWD, ECMWF and EUMETSAT) and complementary in-situ data are processed interoperably without major technical effort.

Contribution to the success factors:

Measure EUM-HF 2.3: Establishing and continuously developing a central natural hazards portal

Description:
With the 'DWD Natural Hazards Portal', we plan to establish a central platform for prevention, warning and information before, during and after extreme natural events (e.g. wildfires or floods). Data and information on acute situations as well as preventive climatological risk indicators

Floods in Germany

should be readily available for this purpose. Satellite data plays a key role for data assimilation in numerical weather prediction.

An important step towards making the wealth of information generated by the European satellite infrastructure widely usable is to integrate further user-focused operational satellite data products into the portal.

Objective:

- Thanks to the quick availability of processed data and information, the population, authorities and industry are prepared for extreme events and can react better in the event of emergencies.

Contribution to the success factors:

Action area ‘Communication and networking’

Many (potential) users are not yet sufficiently aware of the wide range of weather-related data already available today and the numerous value creation opportunities resulting from this. Even experienced users are sometimes not up to date on provision models, innovations in specialized use cases or new products. Therefore, as part of this action area, we want to improve communication and simplify access to information in order to increase awareness and knowledge of the public services available. At the same time, we wish to strengthen network structures in order to promote the exchange of professional expertise on potential applications, both among users and between users and data providers. In light of these aspects, the following measures are planned for EUMETSAT’s meteorological programmes in the ‘Communication and networking’ action area:

Measure EUM-HF 3.1: Integrating information on meteorological services in a central information platform on Earth observation

Description:

The many different data and information platforms make it difficult for users to gain an overall overview of services and potentials of climate- and weather-related data and products. The measure described under COP-HF 3.1 to set up a central information platform on Earth observation is intended to ensure that a broader target group can find details on meteorological programmes and missions as well as information on possible applications.

Objective:

- Expanding the user base for the meteorological data, services and products offered by EUMETSAT and the DWD, among others, by providing information and sample applications centrally via a new information platform on Earth observation.

Contribution to the success factors:

Measure EUM-HF 3.2: Evolving the communication policy on changes in the range of publicly available weather- and climate-related data and products

Description:

The publicly generated weather- and climate-related data is of key importance for the products of many value-added service providers. Even minor changes to this data can cause significant problems when it comes to utilizing the data. Even if users are already proactively informed about adjustments to the product range or how the technology is provided via existing communication channels (e.g. newsletters, workshops, DWD expert discussions), this relevant information does not yet reach all user groups. Alternative communication channels (e.g. social media or integration into the retrieval algorithms) will be examined and established to ensure that information about the constantly evolving range of data and products reaches the audience necessary.

Objective:

- User groups are always informed about the latest changes and thus make the best possible use of the data and products.

Contribution to the success factors:

Action area ‘Resources and expertise’

Data from the EUMETSAT satellites as well as the (processed) weather-related data derived from it is highly complex. Trained specialists and significant computing resources are required to process the data. We have already addressed this challenge by giving public value-added service providers (especially the DWD and ECMWF) a strong role in the weather and climate data ecosystem and will work towards overcoming it by making improvements to the product range as described above. Another goal in this action area is to optimize the ability of (public) users to act by increasing the range of available training programmes and facilitating the provision of computing capacities for public sector users. In light of these aspects, the following measures are planned for EUMETSAT’s meteorological programmes in the ‘Resources and expertise’ action area:

Measure EUM-HF 4.1: Strengthening technical expertise in public administration with regard to using weather- and climate-related data and products

Description:
In order to be able to put the constantly growing range of weather- and climate-related data and products to optimal use in public administration, users need to acquire and continuously develop the relevant expertise. Existing training and continuing education programmes should therefore be evaluated and expanded to ensure that the necessary skills are available at public authority level.

Objective:
- Users in public administration have the necessary expertise to use weather- and climate-related data and products.

Contribution to the success factors:

Measure EUM-HF 4.2: Expanding the user base of the European Weather Cloud in Germany as a computing resource for processing weather- and climate-related data

Description:
The further processing of weather- and climate-related data also requires computing resources, of which public administration does not have an unlimited supply. Expanding the user base of the European Weather Cloud has provided infrastructure with significant computing capacities, designed to process complex weather- and climate-related data. For this reason, we want to lay the foundation for the European Weather Cloud to focus even more strongly on the needs of public stakeholders outside the German Meteorological Service in order to make its benefits available to a wider target group.

Objective:
- Public administration uses existing computing capacities for the (further) processing of weather- and climate-related data.

Contribution to the success factors:

Measure EUM-HF 4.3: Promoting innovation on the basis of EUMETSAT programmes

Description:
Especially in areas of application that are still underutilized, innovative ideas need to be supported in order to identify, implement and perpetuate potential applications in the long term. Using modern tools and methods, such as AI and digital twins, can simplify and expand the use of data from the EUMETSAT programmes. They also allow us to open up new areas of application. As a result, the Federal Government is working to ensure that the EUMETSAT programmes related to AI, cloud and applications are further developed and expanded in order to promote innovative products and data processing methods on the basis of the products and services of the EUMETSAT satellite programmes as well as of other Earth observation programmes. We aim to make the development of innovative applications a permanent part of the EUMETSAT programmes and to discuss synergies as well as cooperation opportunities.

Objective:
- The EUMETSAT application programmes are optimized to develop novel robust methods and applications and to operationalize these in a simple manner.
- End users make use of innovative applications for their operational processes on a long-term basis.

Contribution to the success factors:

Action area ‘Regulatory Framework’

It is generally only in individual cases and in sensitive areas of application that a regulatory framework impacts the utilization of weather- and climate-related data. For these cases, we intend to ease the respective regulations, provided this makes sense and would simplify or even enable increased use. Likewise, we will regularly re-evaluate the contractual conditions for using publicly generated weather-related data in an open-ended manner. In light of these aspects, the following measures are planned in this action area:

Measure EUM-HF 5.1: Ongoing re-evaluation of regulatory framework in order to increase use of weather- and climate-related data

Description:
We want to regularly review laws and the regulatory framework related to the provision and use of meteorological and climatological data. In doing so, we want to ensure that any obstacles to generating added value from public weather- and climate-related data are removed as far as possible. Users themselves are to be given the option of reporting any adjustments they consider necessary in a structured and continuous needs assessment of the DWD.

Objective:
- Re-evaluating the regulatory framework in an ongoing manner and thereby identifying relevant regulations that can be eased makes it possible to expand and increase the use of weather- and climate-related data in a legally watertight manner.

Contribution to the success factors:

Measure EUM-HF 5.2: Updating contractual and licence agreements on the use of publicly generated weather- and climate-related data

Description:
Although a large proportion of publicly generated data and products are freely available, their use is still usually subject to licence conditions. This measure is intended to ensure that the contractual and licence conditions are continuously reviewed and regularly modified on the basis of international experience.

Objective:
- Continuously updated licence conditions and standard contracts maximize the flexibility and extent of data and product use by value-added service providers and end users.

Contribution to the success factors:

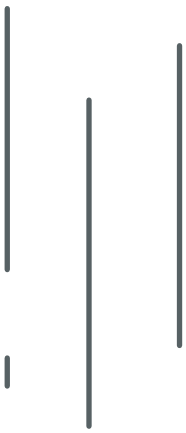
Outlook

The Copernicus and Galileo satellite programmes and the EUMETSAT meteorological programmes are the cornerstone for many applications and added value in society and industry. With this Strategy, we, as the Federal Government, enable users to harness data, services and products from these three programmes and expand their use.

We are also helping to attract new users and add potential new use cases. This makes the Strategy an important contribution to strengthening German and European security and sovereignty, adding value and boosting competitiveness, future-proofing Germany and enhancing its efficiency and supporting climate action and environmental protection.

We are flanking implementation of the Strategy with structured and continuous monitoring. This allows us as the Federal Government to regularly check the implementation progress and suitability of our suite of measures. As a basis for the monitoring, we will flesh out the presented measures of the Strategy during their implementation and lay down responsibilities and time horizons.

Concurrently with the duration of the EU Space Programme, we will verify in 2027 whether action areas and measures are to be adapted to new developments at EU level. We plan to evaluate the Strategy in 2029 to allow it and the relevant measures to be updated.



Glossary of abbreviations

Abbreviation	Explanation/long form
AI	*Artificial Intelligence*
Beidou	*Global Chinese satellite navigation system*
BKG	*Federal Agency for Cartography and Geodesy*
BMDV	*Federal Ministry for Digital and Transport*
BMUV	*Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection*
BUFR	*The Binary Universal Form for the Representation of meteorological data is a data format used and updated by the WMO*
CODE-DE	*Copernicus Data and Exploitation Platform – Copernicus data and cloud processing for German authorities*
DEP	*Digital Europe, now DIGITAL*
DestinE	*Destination Earth – flagship initiative of the European Commission to develop a highly accurate digital model of the Earth*
DLR	*German Aerospace Center*
DWD	*German Meteorological Service*
ECMWF	*European Centre for Medium-Range Weather Forecasts*
EEA	*European Environment Agency*
EMSA	*European Maritime Safety Agency*
EPS	*EUMETSAT Polar System – European polar-orbiting weather satellites programme*
EPS-TG	*EUMETSAT Polar System Third Generation*
ESA	*European Space Agency*
EU	*European Union*
EU DTO	*European Digital Twin of the Ocean*

Abbreviation	*Explanation/long form*
EUMETSAT	*European Organisation for the Exploitation of Meteorological Satellites*
EUSPA	*European Union Agency for the Space Programme*
EU-SST	*EU Space Surveillance and Tracking*
EWSS	*Emergency Warning Satellite Service*
FRONTEX	*European Border and Coast Guard Agency*
GEO	*Group on Earth Observations – international group for the coordination and provision of global Earth observation infrastructure*
GLONASS	*Global Russian satellite navigation system*
GNSS	*Global navigation satellite system*
GOVSATCOM	*Governmental Satellite Communications – European Union programme for governmental satellite communications*
HAS	*High Accuracy Service*
IMAGI	*Interministerial Committee for Geoinformation*
IRIS2	*Infrastructure for Resilience, Interconnectivity and Security by Satellite – planned satellite constellation for universal internet coverage*
IT	*Information Technology*
JRC	*Joint Research Centre*
KRITIS	*Critical infrastructure*
M4G	*Meteosat 4th Generation*
MOI	*Mercator Océan International*
NAVSTAR GPS	*Navigational Satellite Timing and Ranging Global Positioning System – the openly available GPS service*
netCDF	*The Network Common Data Format is a data format for the exchange of scientific data*
OS	*Open Service*

Abbreviation	Explanation/long form
OS-NMA	*Open Service Navigation Message Authentication*
PRS	*Public Regulated Service*
SAF	*Satellite Application Facility*
SAPOS	*Satellite positioning service of the German State Surveying Agency*
SAR	*Search and Rescue Service*
SatCen	*European Union Satellite Centre*
SKD	*Satellite-based crisis and situation service*
UN	*United Nations*
WMO	*World Meteorological Organization*

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