Framework Partnership Agreement for Copernicus User Uptake

Coordinated by

DLR German Space Agency at DLR

FRAMEWORK PARTNERSHIP AGREEMENT FOR COPERNICUS USER UPTAKE

HIGHLIGHTS AND ACHIEVEMENTS

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FOREWORD

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“The European Union’s Space Programme shines as an example of innovation and ambition. It empowers our citizens, businesses, and public authorities with world-class infrastructure and transformative services that unlock the limitless possibilities of space. One of its components is Copernicus, the remarkable Earth Observation programme of the EU. Copernicus provides timely, accurate, and freely accessible data to monitor our planet’s environment, helps combating climate change, and informs decisions on security, sustainability, and public policy. Yet, the true power of these technologies lies not only in their creation but also in their application: translating data into real life solutions that empower society, drive economic growth, and advance environmental stewardship.

To unlock this potential, the European Commission has led initiatives to close the gap between space data and its practical use. Central to these efforts is the Framework Partnership Agreement for Copernicus User Uptake (FPCUP), a multi-year initiative named in honour of the pioneering astronomer Caroline Herschel. FPCUP embodies the EU’s commitment to ensuring that Copernicus data reaches its full audience, fostering innovation, and addressing real-world challenges with precision and purpose.

The European Union’s Space Programme is a powerful engine of innovation, delivering solutions that support urban planning, disaster response, environmental protection, and smart agriculture, benefitting citizens, businesses, and public authorities alike. By strengthening collaboration with national stakeholders, fostering cross-border and international partnerships, and catalysing the development of groundbreaking applications, FPCUP has become a driving force in expanding the reach of Earth Observation. Its 50 partners from 23 European countries work in unison to grow the user base, stimulate markets, and transform raw data into tools that create value across industries and communities.

As you explore the pages ahead, you will discover the full impact of FPCUP: from pioneering downstream applications to fostering international partnerships and advancing knowledge-sharing. These stories illustrate how science and innovation unite to transform our understanding of the planet and our ability to protect it. Together, we are not merely observing Earth – we are shaping its future.”

Mr Christoph Kautz, Director for Space Policy, Satellite Navigation and Earth Observation, Directorate-General for Defence and Space (DG DEFIS), European Commission

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“From the very beginning, Germany has been a strong advocate and supporter of Copernicus. More than ten years after the launch of the Sentinel-1A satellite, we look with pride on the fascinating development of an extensive satellite fleet and operational European Earth Observation services. The FPCUP project, coordinated by the German Space Agency at DLR, had the important task of bringing forward the Copernicus user uptake with the goal of maximising the value of the EU investment in Copernicus. Together with 50 European partners in the FPCUP consortium, we have learned a lot about how Copernicus can help – from the local and regional level within a country to collaborative solutions developed by several countries together. More than 850 events have been organised, including trainings, workshops and networking meetings, and more than 150 Copernicus-based applications have been developed based on the needs of local or national users. This booklet provides a subset of what has been achieved – and is also a plea to continue investing in Copernicus User Uptake.”

Dr Walther Pelzer, Director General of the German Space Agency at DLR and Member of the DLR Executive Board

#EU Space
COPERNICUS USER UPTAKE

INTRODUCTION

Copernicus User Uptake: Significance and Opportunities

Copernicus delivers a wealth of satellite data, services, and products to its users. It ensures an autonomous access to environmental information and key technologies for Earth Observation. Copernicus supports the EU and its Member States in taking independent decisions and actions in the fields of the terrestrial and marine environment, climate change, forestry, agriculture and rural development, civil protection, infrastructure monitoring, security, preservation of cultural heritage, as well as the digital economy. As an operational and user-driven programme, Copernicus has written a remarkable success story, not least thanks to its free and open data policy.

Core users of Copernicus are European, national, and regional public bodies and institutions with tasks related to environmental management, agriculture and forestry, civil protection and security etc. This multitude of different stakeholders at different administrative levels has not necessarily been waiting for a European Earth Observation programme to solve their problems. Many of them have well-established ways of working and are initially sceptical about new technologies. Against this background, it is important to implement measures for Copernicus user uptake, i.e. to enter into a dialogue with potential users, exchange information and find out together where and under what conditions Copernicus services and products can actually be helpful for them. The informative value of Earth Observation-based products needs to be demonstrated, but their limitations also must be revealed. Low-threshold offers, if possible in the respective national language, are needed in order to really reach as many functionaries as possible.

Information derived from Copernicus can serve such different questions as air quality monitoring, the understanding of climatic trends the safety of bathing waters, forest monitoring, timely warning of floods and droughts, the protection of habitats and biodiversity, the recognition of risks related to ground subsidence, quick assessment of the situation in crisis areas, and urban planning in the face of increasing summer heat. This list could be extended almost indefinitely. It illustrates why it is only natural that Copernicus has a rather fragmented user landscape. In that sense, Copernicus cannot simply be compared with the other components of the EU Space Programme, such as Galileo and EGNOS. When the European Court of Auditors, in its Special Report 07/2021[1] stated that (Galileo and) Copernicus services had been launched, but that uptake needs a further boost, and that “all relevant actors and entities at their various levels” need to be included, they might not have fully realised what a huge task they had formulated. Copernicus user uptake is a task that cannot be completed within a few years and will continue to arise with new satellites – such as the Sentinel Expansion Missions – and new tasks of public authorities.

The FPCUP project with its 220 actions has entered into an active dialogue with potential users in numerous places. While not having analysed the full complexity of “all relevant actors and entities” in all the EU Member States, it made use of a bottom-up approach to achieve progress where it was most needed. This approach made it possible to approve numerous action proposals that appeared relevant and important. Many of these proposals would have fallen by the wayside in a more competitive tendering process, which often results in only very experienced actors receiving funding. However, it is precisely those actors who have had limited or no experience with Copernicus that should be involved in order to bring Copernicus to the user. Many users who did not necessarily recognise the benefits of the EU Space Programme in its entirety at first glance may have realised that there is a specific Copernicus product or application that truly helps them in their daily work. And that is what user uptake is about.

FPCUP has also shown interesting developments from the beginning to the end of the project. In the initial phase, general networking and awareness-raising activities made up a large part of the annual work programmes. Later, however, more specific actions were proposed, and joint activities carried out in several EU Member States became more important. There are common or similar problems in different countries. One of FPCUP’s success stories is solving them together, learning from each other and still implementing individual solutions according to the respective needs.

User uptake is a complex endeavour. It must be continued and taken seriously in order to gain the maximum benefit from this great European Earth Observation programme called Copernicus.

In this booklet, we highlight some of the activities that were carried out in 220 actions to increase the awareness, uptake, and integration of Copernicus data and services. To gain a comprehensive understanding, both by reflecting on past achievements and anticipating future developments, we conclude by examining the innovation potential and strategic opportunities that have emerged from FPCUP.

[1] https://www.eca.europa.eu/Lists/ECADocuments/SR21_07/SR_EUs-space-assets_EN.pdf

UNDERSTANDING FPCUP – A PROJECT OVERVIEW

The Framework Partnership Agreement for Copernicus User Uptake (FPCUP) represents a significant initiative of the European Commission. Its foundation was laid within the Copernicus User Uptake Strategy[1], which focused on maximising the benefits of Copernicus data and services for society and the EU economy. To achieve this goal, the strategy identified objectives, key principles and actions to enhance and expand the use of Copernicus data and services across Europe by empowering national and regional stakeholders. The FPCUP project, initiated in July 2018 and funded by the European Commission (DG DEFIS), was coordinated by the German Space Agency at the German Aerospace Center (DLR) and implemented by a consortium of 50 partners in response to an EU call to establish the Caroline Herschel Partnership Framework Agreement.

Over the past seven years, FPCUP has not only promoted the value of Copernicus, but has actively contributed to building a more resilient, connected and innovation-driven ecosystem of users. This has been particularly crucial in light of the paradigm shift introduced by Copernicus itself: the transition from limited availability of Earth Observation data to an unprecedented wealth of data. In this new landscape, the challenge is no longer access, but effective uptake and application — and FPCUP has played a key role in bridging that gap.

The overall objective of FPCUP was to enhance the user uptake of Copernicus by:

- promoting awareness of the vast opportunities offered through its data and services
- building active communities and fostering networks among users and stakeholders
- supporting the development and implementation of user-oriented services and applications, tailored to national and regional needs

The bottom-up approach was one of FPCUP's greatest strengths, empowering its consortium partners to propose actions that responded directly to the needs of local users and national priorities. This approach has proven to be especially effective in increasing the accountability and sustainability of uptake activities.

The ambition of FPCUP is reflected in its scope and reach: 50 partners from 23 European countries have worked collaboratively under this framework, supported by a total budget of € 22.6 million, co-funded by the European Commission (85 %) and the consortium partners (15 %). Between 2018 and 2025, a total number of 220 individual actions were implemented to promote Copernicus user uptake. These actions were approved by the European Commission and structured in 21 Specific Grant Agreements (SGAs), all governed by a Framework Partnership Agreement (FPA).

[1] https://op.europa.eu/en/publication-detail/-/publication/62101cd2-fbba-11e5-b713-01aa75ed71a1

Figure: FPCUP Consortium Members and Participants of the 2nd FPCUP Workshop, September 2024, Bonn, Germany. ©DLR.

The FPCUP Work Programmes (WPs) were developed annually in a collaborative process. The General Assembly, composed of all consortium partners, defined key thematic priorities. Partners were then invited to submit action proposals in response to internal calls. These proposals were carefully reviewed and evaluated by the Leadership Group – the representative and elected main working group for the consortium – based on criteria such as relevance, innovation potential, user engagement, and alignment with Copernicus objectives. Final approval rested with the European Commission, which formally endorsed each SGA.

FPCUP actions were organised into three strategic tiers:

Tier 1 – National user uptake activities

These actions promoted the use of Copernicus data by national stakeholders, e.g. through national or local awareness events, application development for public information, or training courses tailored to the needs of public authorities.

Tier 2 – Cross-border and international actions at the European or global level

European cross-border user uptake: These actions were organised between multiple Member States to increase awareness through joint events, exchange best practices and create common products and applications. This is especially relevant for regions that extend across national borders (e.g. the Baltic Sea region).

In addition, there were international initiatives that promoted the use of Copernicus data globally and aimed to strengthen international cooperation, particularly in Asia, South America, and Africa.

Tier 3 – Development of business solutions and innovative products and applications

These actions aimed to support innovative businesses and start-ups in the commercial Earth Observation sector by providing various resources, including funding opportunities, technical support, training programmes, and networking events.

Figure: FPCUP Member States

These objectives were pursued through a diverse approach, ranging from hosting information and training events to engage and empower users, establishing or expanding user fora to facilitate active dialogues, to developing and piloting downstream applications and services, and leveraging innovative formats, such as hackathons and match-making events to communicate Copernicus in new and engaging ways.

Through this multifaceted, user-driven architecture, FPCUP has become a catalyst for regional, national, transnational and international user uptake of Copernicus, as well as a model for a collaborative funding mechanism in Europe.

The distribution of funds across the three strategic tiers of FPCUP — Tier 1 (national), Tier 2 (cross-border and international), and Tier 3 (business solutions) — was relatively balanced.

A comparison between the four work programmes illustrates the evolution of the project: While in the first two years of the project there were mainly activities at national level (See figure on page 10), and the budget per action was rather low (See figure below), the following work programmes increasingly funded larger actions. These were in particular measures from Tier 2, i.e. international and cross-border activities. This reflects the increasing collaboration within the consortium as the project progressed. In addition, the distribution of the budget also shows that, in contrast to the early stages of the project, the later work programmes focused more on market uptake activities.

The outcomes achieved show the significant impact of FPCUP. The programme has exceeded its initial targets in many areas. One major task was to promote the opportunities of Copernicus. With the support of actions under FPCUP, more than 25,000 participants from various user groups were reached through over 850 events.

Moreover, a large number of user-oriented resources in more than ten European languages were created that are publicly available on the website: over 1,000 materials have been produced, including publications, presentations, applications, training and communication materials, user dialogue platforms, and data portals. All of these contribute to the sustainable dissemination and application of Copernicus data and services.

Together, the results emphasise FPCUP's role as a key driver in transforming access to Earth Observation data into tangible benefits for users across Europe and beyond. To illustrate this with concrete examples, the following pages highlight selected FPCUP actions and their impact on various levels.

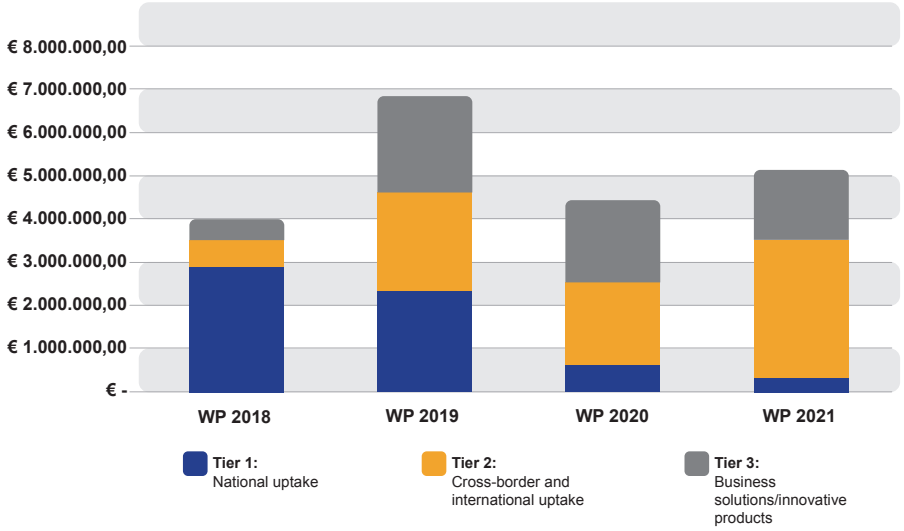

Figure: Budget per Work Programme and Tier

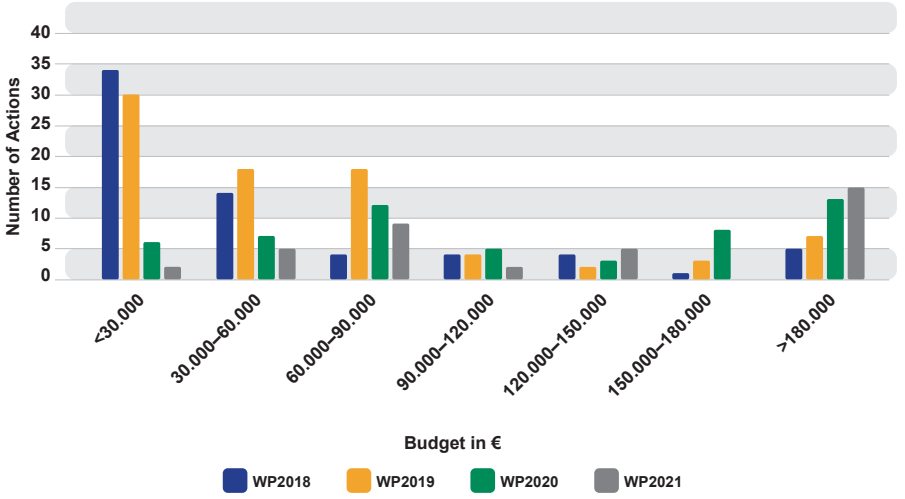

Figure: Number of Actions per Budget Category

BEYOND THE SATELLITES – INTERACTIVE BORDERLESS EMPOWERMENT OF SATELLITE DATA

General Information

- **Institution:** Austrian Research Promotion Agency (FFG)
- **Duration:** 07/2022 – 08/2023
- **Primary topic:** education
- **Target users:** general public
- **Type of Action:** Building an active user dialogue, national and multinational information/training events

Content and Results

The main objective of the action „Beyond the Satellites“ was to create an exhibit, also known as „Copernicus for Research and Innovation in Austria“ (CORINNA), to educate and raise awareness among the general public about the crucial role of Copernicus satellite data in society, particularly in understanding and addressing climate change. Through an interactive and engaging experience, the exhibit aims to connecting regional and global climate contexts, illustrating the impacts of climate change with visually compelling and intuitive interfaces. Ultimately, it seeks to enhance public understanding of environmental challenges and highlight the significance of Earth Observation services in tackling them.

The Beyond the Satellites (CORINNA) action began with FFG identifying Ars Electronica Center Linz (AES) as the ideal partner to bring the project to life. FFG and AES then collaborated to develop and implement an interactive exhibit showcasing the value of Copernicus data in climate research and innovation in Austria. AES designed the exhibit concept, while FFG ensured compliance with key requirements, curated relevant Earth Observation (EO) content, and selected Copernicus examples to highlight their national and European significance. The exhibit features a multi-screen setup with interactive “data windows” and a camera that captures and dynamically displays audience movements, fostering a deeper understanding of climate change and EO data. The exhibit has been successfully presented at major events in Austria, engaging a diverse, international audience.

The primary outcomes of the action are:
- The successful creation of the “Beyond the Satellites (CORINNA)” exhibit
- increased awareness about the value of Copernicus data in understanding climate change and supporting research and innovation
- Engagement with a diverse, international Audience

The main beneficiary of the Beyond the Satellites (CORINNA) action is the general public in Austria. The exhibit helps them understand the broad relevance of Earth Observation data in various aspects of daily life, from monitoring environmental changes to improving urban planning, agriculture, and disaster management. By engaging with the exhibit, visitors gain insight into how Copernicus data supports practical applications that directly impact their communities and enhance quality of life.

Figure: Copernicus for Research and Innovation in Austria (CORINNA) exhibit (©FFG).

Impact and Future Potential

Particularly successful was the use of an art installation to convey the value of Earth Observation data. The interactive exhibit effectively engaged the public effectively, offering a fresh and intuitive way to experience and understand Copernicus data, making complex information both accessible and memorable.

FFG is currently planning to continue the activities of the Beyond the Satellites (CORINNA) action. Following the FPCUP action, the platform will be exhibited at additional locations across Austria, potentially including main railway stations, airports, and various events or conferences. Funding for these follow-up activities may come directly from FFG, but also further options, such as offering the platform to interested institutions for future use and collaboration are being considered.

There is potential for wider application and innovation, as the Beyond the Satellites (CORINNA) exhibit could be expanded from its current focus on the benefit of EO-data for the selected topic of climate change to other fields such as urban planning, disaster management, sustainable energy and more. Its interactive approach offers opportunities to innovate in how scientific data is made accessible and engaging to the public, with strong potential for expansion through partnerships with various institutions.

CREATING A PERMANENT NATIONAL WORKING GROUP TO COORDINATE EO-BASED ACTIVITIES IN THE FRAME OF THE ITALIAN PRESIDENCY OF THE COUNCIL OF MINISTERS

General Information

- **Institution:** the Italian Institute for Environmental Protection and Research (ISPRA)
- **Running time:** 09/2021 – 10/2023
- **Primary topic:** governance
- **Target users:** public sector (national, regional and local), private sector
- **Type of action:** building an active user dialogue

Content and Results

The aim of this action was to improve the downstream market potential and uptake, based on identified user needs, in order to expand the national commercial capacity to develop EO-based services for public and private applications, creating a permanent National Working Group in the frame of the Italian Presidency of the Council of Ministers.

One of the main activities within this initiative was to bring together representatives from all user communities served by the Italian National User Forum (UFN). The UFN has consistently represented a platform for development and discussion, providing valuable insights for all user communities engaged with space services and applications. As a result, it has become a key reference point for shaping national space policies, where user needs and requirements play a crucial role in driving satellite technology advancements. In this context, we brought together users from various sectors to define new national interest monitoring services. This collaborative approach helps to identify priorities that can inform initiatives across scientific, technological, and operational development, benefitting both the public and private sectors. The multi-sector ecosystem involved includes government agencies (state, regional, and local bodies), universities, industries, non-profit organisations, and local commercial end-users of Earth Observation (EO) services.

Figure: Cloud-free view of Italy, April 2022. (© European Union, Copernicus Sentinel-3 imagery.)

The primary outputs include identifying specialised sectors that are missing from the national territory and fostering their development, as well as recognising existing specialisations and supporting further growth through targeted interventions and resource optimisation. Based on the European Cluster Collaboration Platform taxonomy, the following smart specialisation sectors were identified, along with the number of technological clusters within the national territory: Agriculture (6 clusters), Blue Growth (3 clusters), Digital Agenda (16 clusters), Energy (4 clusters), Health and Social Work (5 clusters), Public Health & Security (9 clusters), Sustainable Innovation (11 clusters), and Aeronautics and Space (11 clusters). The market value was calculated by summing the revenues from companies' goods sales, focusing on 127 companies in EO services. Revenues were obtained either through interviews (47 companies) or secondary data (80 companies), leading to an estimated EO market value of € 351.548 million in 2021. The main beneficiaries of these results are Italian commercial user communities and governmental bodies.

Impact and Future Potential

One of the mayor achievements of this action was the support to the creation of the Governmental Space Office in Italy, which had a significant impact on the EO and Copernicus sector in Italy. One of the challenges in establishing the Space Office was bringing together all of the actors needed to identify benefits for the commercial sector. The activities of this action are continuing within the frame of the Italian National Copernicus User Forum.

DEVELOPING A BEST PRACTICE CATALOGUE FOR THE USE OF COPERNICUS IN THE PUBLIC SECTOR IN DENMARK

General Information

- **Institution:** Danish Agency for Data Supply and Infrastructure (SDFI)
- **Duration:** 11/2018 – 11/2021
- **Primary topics:** atmosphere, climate change, Copernicus data, Copernicus in general, Copernicus user needs, emergency, energy, health, land, marine, security, arctic, sea ice, Greenland, glaciers
- **Target users:** public sector (national, regional, local), general public, private sector, research sector, universities
- **Type of action:** building an active user dialogue

Content and Results

The main task of this action was the creation and publication of a best practice catalogue titled “Danish Uses of Copernicus – 50 User Stories based on Earth Observation”. This collection of short articles is aimed at a non-specialist audience, highlighting the use and benefits of Copernicus. The Realm of Denmark has highly varied landscapes, from its numerous agricultural fields and islands of the southern regions to the grassy slopes of the Faroe Islands and the icy and mountainous Greenland in the north. With such vastly spread and large areas to cover, the use of Earth Observation becomes evidently beneficial.

The collection of user stories illustrates both the variety and increasing importance of satellite usage in the public and the private sectors, and shows how Earth Observation satellites are valued at the national, regional and local level. The 50 user stories have been collected from authors across the scientific, public and private domains in Denmark and Greenland in order to showcase the continuously growing usage and application of Copernicus, the Sentinels and Copernicus Contributing Missions throughout the Kingdom of Denmark – and internationally. The diversity of the user stories, both thematically and geographically is vast, demonstrating practices from monitoring and mapping of Arctic sea ice and the Greenland ice cap, over governmental use in support of agriculture, open land and urban planning, to exploitation of artificial intelligence for detection of trees in Africa’s Sahel region. The publication also includes examples of nationwide datasets to monitor infrastructure movements and ground motion, the use of optical imagery to detect submerged aquatic vegetation and urban dynamics. Furthermore, examples are shown on measuring wind resources from space, seasonal surface water in fields and monitoring of atmospheric conditions.

Figure: Mapping of submerged aquatic vegetation in Denmark. The map is produced by DHI GRAS under the Velux Foundation funded project Mapping“ aquatic vegetation in Denmark from space” using machine learning and Sentinel-2 data from the Copernicus programme. (© DHI GRAS A/S.)

The best practice catalogue in English and Danish is available on the FPCUP Website[2]. The main beneficiaries of the results are Governmental bodies, local authorities, private companies, user groups in Greenland and Denmark, researchers and international collaborators within EO.

Impact and Future Potential

The generation of a national overview of examples of use, improved collaboration both nationally and internationally and has proven to be a significant achievement of this action. There is potential for future projects in updating and expanding the existing catalogue of national use stories, however, there is currently no funding available to do so. There is also potential to create a similar overview of national best practices and use cases in other countries and to share information and experiences internationally.

[2] https://shorturl.at/PhCYk

PROMOTING THE USE OF COPERNICUS IN ICELAND

General Information

- **Institution:** Natural Science Institute of Iceland (NSII)
- **Running time:** 02/2023 – 04/2025
- **Primary topics:** Copernicus in general and Copernicus user needs
- **Target users:** public sector (national, regional, local), general public, private sector, schools, universities
- **Type of action:** building an active user dialogue, national and multi-national information/training events, promoting national and multi-national innovative actions

Content and Results

This action introduces Copernicus services and data to diverse stakeholders in Iceland, including students, academia, professionals, local authorities, and businesses. This initiative takes a local approach by providing materials in Icelandic and engaging with users to better understand their needs and potential applications of Copernicus services. The action demonstrated the economic potential and practical benefits of Copernicus data while also raising awareness across different sectors.

Main Activities Conducted:

- Outreach and coverage on Copernicus and its contributions to the economic, academic and public sector. Workshops with academics and entrepreneurs
- Workshop and talks at the annual Explorers Festival and Visindavaka
- Hackathon to encourage students and start-ups to use Copernicus data
- Copernicus ambassador to convey opportunities and promote participation among peers
- Greater general knowledge about Copernicus data and its contribution among stakeholders
- NextGen work with young innovators, STEM students, and secondary schools
- Training material and guidance from NSII

The action delivered several key outcomes to enhance awareness and uptake of Copernicus services in Iceland. These include the Copernicus Ocean Hackathon 2025, engaging students and start-ups in innovative solutions, and Copernicus at Visindavaka 2024, bringing Earth Observation insights to the public. A Copernicus Workshop at the Explorers Festival showcased real-world applications, while NextGen summer events inspired young innovators. Additionally, a Copernicus anniversary event has highlighted achievements and future opportunities. Three specialised workshops on land, marine, and atmosphere services have provided hands-on training, and a dedicated website in Icelandic ensures accessibility of information for local stakeholders. The national sebsite for Copernicus in Iceland, which was created as part of the action, contains promotional and educational material produced during the FPCUP project. The main beneficiaries of these results are local authorities, the general public, students, and private companies.

Figure: Workshop: Copernicus Marine event in Iceland. (©NSII)

Impact and Future Potential

The action successfully introduced Copernicus services to key stakeholders in Iceland, leading to tangible outcomes. Notably, the Health Inspectorate of Reykjavik has begun integrating Copernicus atmospheric data into decision-making processes, demonstrating real-world impact. Furthermore, Landsvirkjun, the National Energy Company, has also issued a letter of intent to facilitate more informed energy strategies using Copernicus services after a successful workshop with their specialist. The Visindavaka 2024 event attracted over 1,000 visitors, many of whom engaged at our booth to learn more about Copernicus while participate in hands-on activities, such as building satellite models for children. The organised workshop series provided valuable insights into the needs of advanced users, showcasing the potential for automating data use through Jupyter Notebook examples. The overwhelming feedback highlights the growing interest and practical applications of Copernicus data in Iceland.

The website will continue to be maintained and updated by NSII to ensure ongoing access to Copernicus information even after the end of the action. Additionally, NSII institution is supporting the Agricultural University of Iceland and the Icelandic Environment and Energy Agency as the CAMS National Contact Point, and is expected to continue this role into the second phase. This ongoing involvement will provide expert support and guidance on Copernicus data and services, fostering further adoption and use in Iceland.

There is strong potential for wider application and innovation in Iceland, with two promising start-ups building their solutions on top of Copernicus data. “Greenfish” is developing predictive and forecasting tools for the marine industry, while “Ecosophy” leverages Copernicus data through EarthOS, a platform that provides real-time insights and analytics for decision-makers worldwide. These innovations highlight the growing impact of Earth Observation data in driving sustainable and data-driven solutions.

SEAMLESS WEB

General Information

- **Institution:** German Meteorological Office (DWD)
- **Running time:** 01/2020 – 04/2024
- **Primary topic:** atmosphere and Copernicus user needs
- **Target users:** public sector (national), general public, private sector
- **Type of action:** building an active user dialogue; developing and piloting downstream applications and services

Content and Results

This action focuses on developing a user-tailored information portal and data platform which is built on the Copernicus Climate Change Service (C3S) and integrates climate forecasts across various timescales. It offers detailed information about the quality of the data. The system automatically updates data, giving users access to the most current information that remains consistent across the sub-seasonal to decadal timescale. A technical workflow to post-process climate predictions, analyse prediction skill, and operationally provide graphs and information on climate predictions has been developed. Documentation of this workflow has been created. The design of the prediction plots was co-developed in collaboration with national users through workshops, questionnaires and personal user contact. A workflow for a preoperational interactive website version of the climate predictions was developed. The workflow for a seamless timeseries, additionally including observation data and climate projections, has also been developed. Documentation of all processes has been made available. Furthermore, this project facilitated the operational publication of all climate prediction data for Germany on the ESGF (Earth System Grid Federation) node.

One of the primary outcomes was the extension of DWD's climate prediction website. The website previously consisted of decadal climate predictions only and was extended to include seasonal and sub-seasonal climate predictions as well as a new method of statistically selected climate predictions for winter (www.dwd.de/climatepredictions). In addition, newsletters on climate predictions and climate projections for Germany were established and a user-friendly design of the prediction results was developed. The main beneficiaries of these results are national users from different sectors (e.g. energy, forestry, water management), as well as the general public.

Schematic representation of the temporal categorisation of Climate forecasts and climate projections

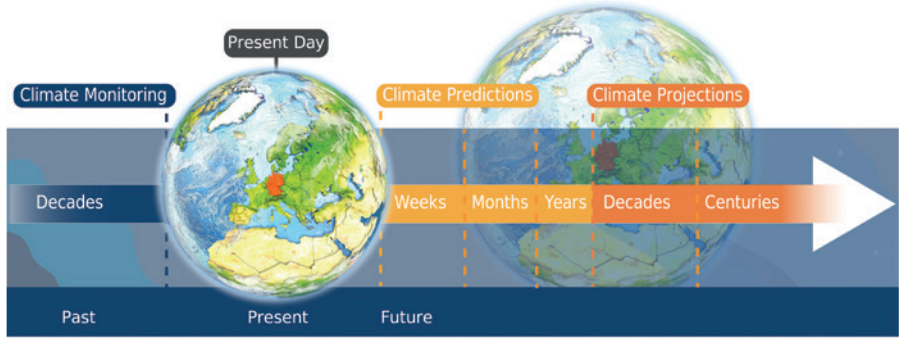

Figure: Schematic representation of the temporal categorisation of climate forecasts and climate projections. (©DWD)

Impact and Future Potential

One task that was particularly successful in this action was the user interaction on prediction ability, which resulted in an explanatory video and the specific design of the established information plots. This proved to be especially important as the presentation of forecast uncertainty, skill and probabilistic forecasts in a user-friendly and understandable way was one of the main challenges of the action.

A potential extension of this action is decadal, seasonal and sub-seasonal predictions on the DWD climate prediction website are now fully operational and maintained by permanent DWD staff. The newsletters are also continued by permanent DWD staff. The pre-operational interactive website and seamless timeseries will be operationalised, and published in DWD, maintained and financed by DWD.

There is potential for a wider application of the action's results. With the addition of further information, such as extreme values and data from multi-model ensembles, the results could be improved, more user demands could be met, and more users could ultimately be reached.

USING EARTH OBSERVATION DATA TO IMPROVE THE PUBLIC HEALTH SYSTEM

General Information

- **Institution:** Romanian Space Agency (ROSA)
- **Running time:** 04/2022 – 12/2023
- **Primary topics:** Copernicus data, health
- **Target users:** public sector (national, regional), research sector, schools
- **Type of action:** building an active user dialogue

Content and Results

The primary goal of this action was to promote the wider use of Earth Observation (EO) data – particularly Copernicus satellite data and its derived information – within the public health system, aligning with global trends, UN and WHO efforts to leverage space science and technology for global health, and the ongoing revision of the national space strategy. The main effort focused on identifying ways of integrating EO derived information, such as temperature, dust, wind, precipitation with relevant in-situ data, such as census, civil registration and population surveys, into public health management processes.

A number of events were organised during the course of this action for discussions on potential methods for integrating diagnostic data with EO data, while considering the needs of the respective fields. These events were also valuable for establishing partnerships with relevant institutions from the public health domain. Therefore, a working meeting was organised at Craiova on the 26 April 2023, with the participation of National Institute of Public Health (INSP), University of Medicine and Pharmacy of Craiova (UMF Craiova) and CS Group Romania. During the meeting, there was a productive exchange of ideas about the integration of EO data with medical data, and the requirements of the medical field, sparked by questions raised about the proposals presented by ROSA and CS Group Romania. Activities were continued in order to identify the potential applications of satellite products for public health purposes. An important activity was finding the correlations between satellite data and public health issues that were presented to us in the previous meetings. In the context of a larger national discussion on access to public sector information (linked to the implementation of the EU Directive), a number of relevant datasets published on the data.

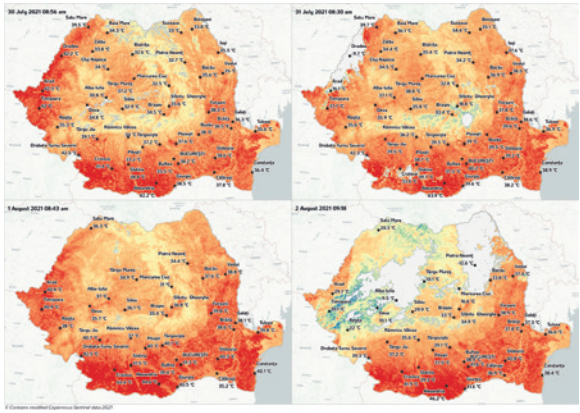

Figure: Maps for tracking the heatwave from July to August, 2021, in Romania. (© European Union, Copernicus Land Monitoring Service 2023. Contains modified Copernicus Sentinel data 2021. © ROSA)

gov.ro website was identified and are being analysed, as they relate to public health status and influencing factors. At the same time, different ways of providing access to relevant data and information for the appropriate authorities are being analysed. As a follow-up to the working meeting, on 21 June 2024, the workshop “Current Challenges on Public Health and Possible Solutions Supported by Earth Observation and Data Analytics” was organised with the support of the DTECLIMATE Consortium, a project developed under the Romanian Recovery and Resilience Programme. The Workshop brought together scientists, policy makers and industry from across Romania. The most pressing needs and information requirements were identified in the context of a global effort to foster dialogue among stakeholders on EO applied research for health – aimed at addressing key challenges and exploring potential synergies between current and future initiatives.

The primary outcomes of this action are research related to Earth Observation data relevant for the public health sector, the organisation of a meeting targeted at representatives from the medical field and determining conclusions on the EO data requirements of the medical field. The main beneficiaries of these results are local public health authorities, universities and private companies from the public health sector.

Impact and Future Potential

The synergies between the scientists, policy makers and public health authorities were a major success of this action. One of the challenges of this action was that each domain has its own specifities, requiring constant dialogue to understand the needs of public health stakeholders. Therefore, this should be a long-term action, not only during a specific project. The action has potential for wider application or innovation. This filed can address various health-related environmental monitoring aspects through big data analytics, artificial intelligence, the effects of climate change and pollution on human health, as well as vector-borne diseases or waterborne infectious diseases.

COPERNICUS FOR MARINE SPATIAL PLANNING AND EU DIRECTIVES

General Information

- **Institutions:** Environmental Hydraulics Institute, University of Cantabria (IHCantabria); National Centre for Space Studies (CNES), Tartu Observatory of University of Tartu (TO), Portuguese Space Agency (PT Space), Cyprus University of Technology (CUT)
- **Running time:** 10/2022 – 10/2025
- **Primary topics:** Copernicus data, Copernicus user needs, marine
- **Target users:** public sector (national, regional), private sector, research sector, universities
- **Type of action:** building an active user dialogue, national and multi national information/training events

Content and Results

The goal of this action was to encourage the use of Copernicus data in the implementation of the EU Marine Spatial planning directive (Directive 2014/89/EU; MSP) focusing on the promotion of sustainable marine resource management and the EU Marine Strategy Framework Directive (Directive 2008/56/EC; MSFD) with the aim of protecting and conserving the EU's marine environment, while also supporting the standardisation of methodologies during the implementation process.

This involves several key tasks:

- Reviewing the official implementation of EU marine directives in Spain, France, Portugal, Estonia and Cyprus
- Identifying data gaps in their implementation
- Determining how Copernicus data can be utilised in this context
- Using Copernicus data to generate high spatial information for the implementation process
- Reflecting on lessons learnt and providing recommendations

The status of implementation of the EU marine directives in Spain, France, Portugal, Estonia and Cyprus has been reviewed. For both marine spatial planning and marine strategy framework directives information about the national laws and competent authorities in the implementation, as well as a description of the different phases undertaken in the implementation process, has been analysed. Each country report includes findings on the identified gaps and on where Copernicus data can add value.

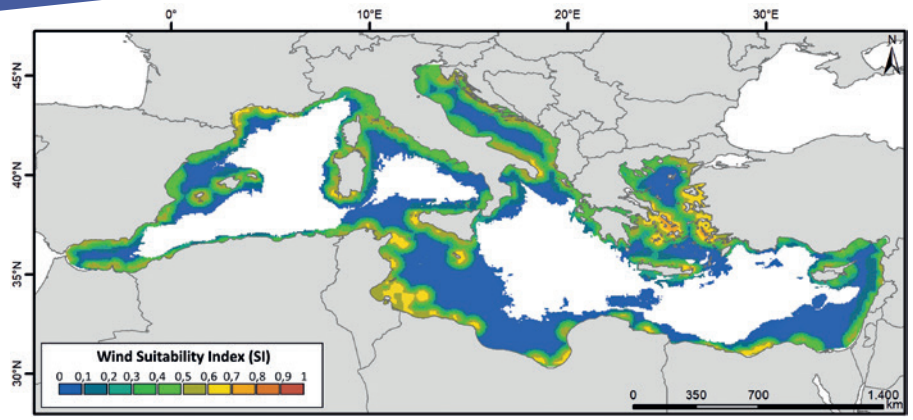

Figure: Wind Suitability Index in the Mediterranean Sea. (©IHCantabria)

Based on a survey conducted, the countries involved are addressing initial perceptions of the main actors of the Copernicus services. This process of aligning the requirements of the marine directives with Copernicus services is being carried out through direct stakeholder discussions and targeted national Copernicus events. The outcome of these efforts is a deeper understanding of the ongoing implementation of both directives at the European level, particularly in terms of identifying data needs and gaps. The Copernicus events in each country have facilitated connections between service providers and end-users, including stakeholders and researchers.

The primary outcome of this action is the identification of data needs for the implementation process of the Marine Spatial Planning Directive (Directive 2014/89/EU; MSP) and the EU Marine Strategy Framework Directive (Directive 2008/56/EC; MSFD) in Spain, Portugal, Estonia, Cyprus and France, and gap filling based on Copernicus data.

The identification of gaps in the implementation of marine directives was a particularly successful part of the action and the main beneficiaries of these results are stakeholders from the national and regional administrations, private sector and public research institutions.

Impact and Future Potential

The objectives of the action have been completed. Data gaps in the implementation of both marine directives have been recognised, as well as the Copernicus products to fill those gaps. The benefits obtained are a better understanding of the evolution of the implementation of these two Directives at European levels and, in particular, of the data needs and gaps that currently exist at European level. Copernicus events in each country have brought Copernicus service providers into contact with end-users (e.g. stakeholders and researchers). There is future potential to focus on the application and to encourage the use of Copernicus data in the implementation of the EU marine spatial planning directives.

Copernicus4Schools – THE GREAT DISASTER CHALLENGE

General Information

- **Institutions:** Norwegian Space Agency (NOSA), Tartu Observatory (TO), Portuguese Space Agency (PT Space), Italian Institute for Environmental Protection and Research (ISPRA), Space Research and Technology Institute, Bulgarian Academy of Sciences (SRTI-BAS), Cyprus University of Technology (CUT), Charles University Prague (CUNI), German Aerospace Center (DLR), Austrian Research Promotion Agency (FFG), Environmental Hydraulics Institute, Spain (IHCantabria), Spanish National Institute of Aerospace Technology (INTA), Romanian National Meteorological Administration (MeteoRomania)
- **Running time:** 01/2023 – 10/2025
- **Primary topics:** climate change, Copernicus data, Copernicus in general, emergency
- **Target users:** schools
- **Type of action:** national and multinational training event

Content and Results

The overall objective of this action was to inspire pupils, as well as teachers, to use and better understand the Copernicus programme and the possibilities that lie within Earth Observation data. This is done through the Great Disaster Challenge, a learning event taking place simultaneously in all eleven participating countries. In total around 1,700 pupils from around 100 classes participated in the challenge.

The activity focused on developing a methodology for the learning event, as well as a teacher training programme. Great efforts were made to promote the event and programme to teachers within the participating countries, through videos, social media and direct contact, and frequent coordination between the implementing partners. Finally, planning the logistics and communication of the event day, both on national and international level, has been a main activity in the last months of the action.

The primary outcome of the action is a methodology that familiarises pupils with Earth Observation images and natural disaster response through a fun and intense classroom activity. The pupils navigate through a flooding scenario through teamwork and gamification, and the challenge was followed up by an international exchange of experiences between classes from different countries. Additionally, the activity has produced a learning course for teachers, introducing Earth Observation, Copernicus and GIS. The methodology and teacher training programmes are available on the FPCUP website. The main beneficiaries of the results achieved are teachers and pupils.

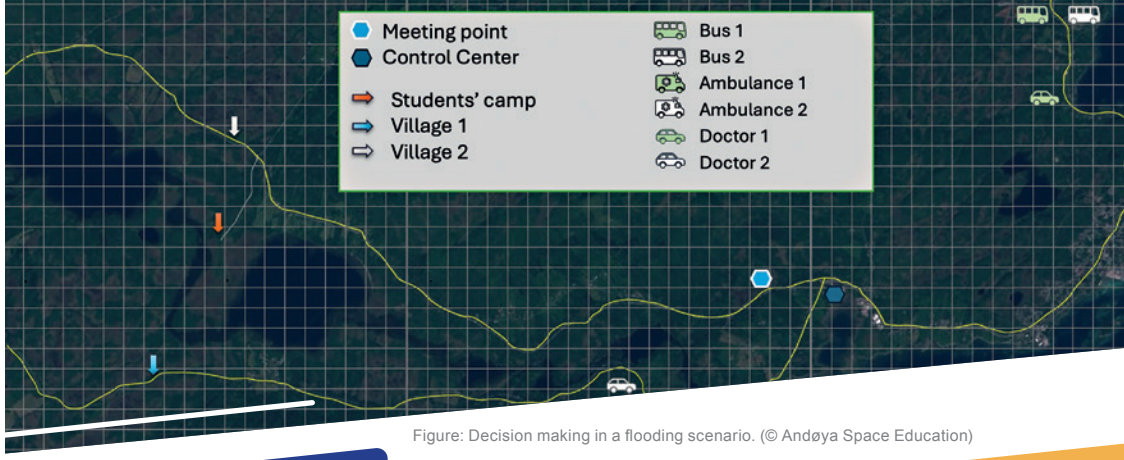

Figure: Decision making in a flooding scenario. (© Andøya Space Education)

Impact and Future Potential

A particular success of the action were the connections between the consortium partners and the teachers involved, which will be a highly useful network for any follow-up activities. The European scope of this action has expanded networks among schools, educators, and organisations, fostering cross-cultural collaboration and knowledge exchange. It also benefits educators with professional development and practical tools for integrating Earth Observation into teaching. Additionally, the different perspectives from the activity partners have been of great value in shaping the methodology.
One of the mayor challenges within the action was to coordinate a simultaneous event across eleven countries, due to different time tables and school calendars for the teachers and pupils. This was especially challenging for the international sessions of the event, which depended on a live link between three classes from different countries. Good communication between the national coordinators was essential to address this. Furthermore, FPCUP as an international project has helped to enable this international common undertaking, to increase the presence of Copernicus in classrooms around Europe.
Now that the materials have been produced, it will be possible to repeat the action, both by individual teachers as well as through another international event day. A survey was sent to the teachers implementing the activity in their classrooms, and lessons learnt will be summarised for a potential second edition of the great disaster challenge. There is currently no plan to fund this, but as it aligns with the mission of many participating partners, and the materials are already produced, a continuation through existing budgets or minor extra funding might be feasible.

The methodology focuses on a flooding scenario, but there is potential to adapt the challenge to other natural disasters. Additionally, the methodology could be developed into a simple video game as part of a learning programme or website.

COPERNICUS UPTAKE AMONGST REGIONAL GOVERNMENT REPRESENTATIVES BY ENGAGING STUDENTS

General Information

- **Institution:** Institute of Geodesy and Cartography (IGiK), Poland
- **Running time:** 09/2020 – 09/2023
- **Primary topics:** atmosphere, climate change, Copernicus data, land, marine
- **Target users:** public sector, private sector, research sector, universities
- **Type of action:** building an active user dialogue, developing and piloting downstream applications and services, promoting national and multinational innovative actions

Content and Results

This action aimed to enhance the application of services based on Copernicus data among regional governments by providing solution concepts and business models for their implementation, developed by students. The goal was to bridge the gap between regional governments, which were not fully utilising satellite data in their activities, and the top students in the region. In addition, the action has increased universities' interest in including Earth Observation in their educational programmes, thus boosting investment in this domain.

Two editions of hackathons were organised across eight universities in cities throughout Poland. Students worked on solutions to regional challenges using Copernicus data. The hackathon, called HackVision, was held in November 2022 with more than 30 teams from eight cities.

At the regional level, seven teams were selected to enter the final competition. Each team presented an outline of their concept and ideas for solving local problems, which had been previously analysed on the basis of national intelligent specialisations, tailored to the specifics of each region. Then, with the participation of specialists from IGiK and representatives of the companies Absiskey and Orbify, as well as local business representatives, eight final teams were chosen. A final conference was organised with the participation of seven teams. During the conference, organised at the Brain Embassy in Warsaw, the final solutions, which included a description of the project, development plan, and budget, were presented both in-person and online.

Figure: "HackVision" – Hackathon (©IGiK)

The main achievements of the action were an increased awareness for satellite data, enhanced engagement and relationship-building between decision-makers, local authorities and students, the promotion of the Copernicus programme, and the creation of new ideas and applications utilising satellite data. The main beneficiaries of these results are local authorities and students.

Impact and Future Potential

Organising stationary meetings with students across multiple locations was considered to be a definite success. Collaborative efforts with university authorities and administrations in the cities where the hackathons were held played a crucial role in their effectiveness. The active participation of students during training sessions led to the creation of eight innovative business solutions utilising satellite data.

Additionally, one international team from Warsaw University contributed to the event, further enriching the diversity of ideas.

Looking ahead, there is potential for expanding this initiative. Some students already had a clear vision for their business plans, including concepts for launching start-ups and collaborating with businesses. While the technological aspects of these solutions are still evolving, the training sessions and workshops conducted throughout the project helped enhance the technical quality of the students' work. Notably, those working under the mentorship of a university professor or doctor demonstrated a high level of scientific awareness and insight.

The potential for broader application or innovation depends on the continued development of the proposed solutions, offering exciting possibilities for future growth.

COPERNICUS USER UPTAKE IN AFRICA

General Information

- **Institutions:**
  Institut Scientifique de Service Public (ISSeP)
  Centre National d'Etudes Spatiales (CNES)
  Centre National de la Recherche Scientifique (CNRS)
  Finnish Meteorological Institute (FMI)
  National Observatory of Athens (NOA)
  PRAXI Network/Foundation for Research and Technology – Hellas (FORTH)
  The Italian Institute for Environmental Protection and Research (ISPRA)
  The Space Research Centre of the Polish Academy of Sciences (CBK PAN)
  Atlantic International Research Centre (AD AIR Centre)
  Portuguese Space Agency (PT Space)
  Netherlands Space Office (NSO)
- **Duration:** 10/2022 – 09/2025
- **Primary topics:** climate change, health, Copernicus data, land, Copernicus in general, Copernicus user needs, security
- **Target users:** private sector, research sector, local public sector, universities
- **Type of action:** national and multi national information/training events

Content and Results

The objective of this action is to establish a meaningful, concerted and scalable effort to build Copernicus-related capacities among African Earth Observation expert communities and actor networks to enable knowledge growth. The purpose is to train African trainers in three languages (English, Portuguese and French) and to develop and implement training sessions adapted to local needs and contexts through in a co-design and sustainable approach with African trainers. The Working Group Africa, which carried out this action, consists of eleven institutions from eight European countries.

The main activity undertaken was the development of a Digital Learning Platform with advanced Copernicus training resources in French, Portuguese and English, the creation of a network of African Copernicus trainers, the organisation of webinars, and the co-development and implementation of local training sessions and additional activities in cooperation with "GMES & Africa".

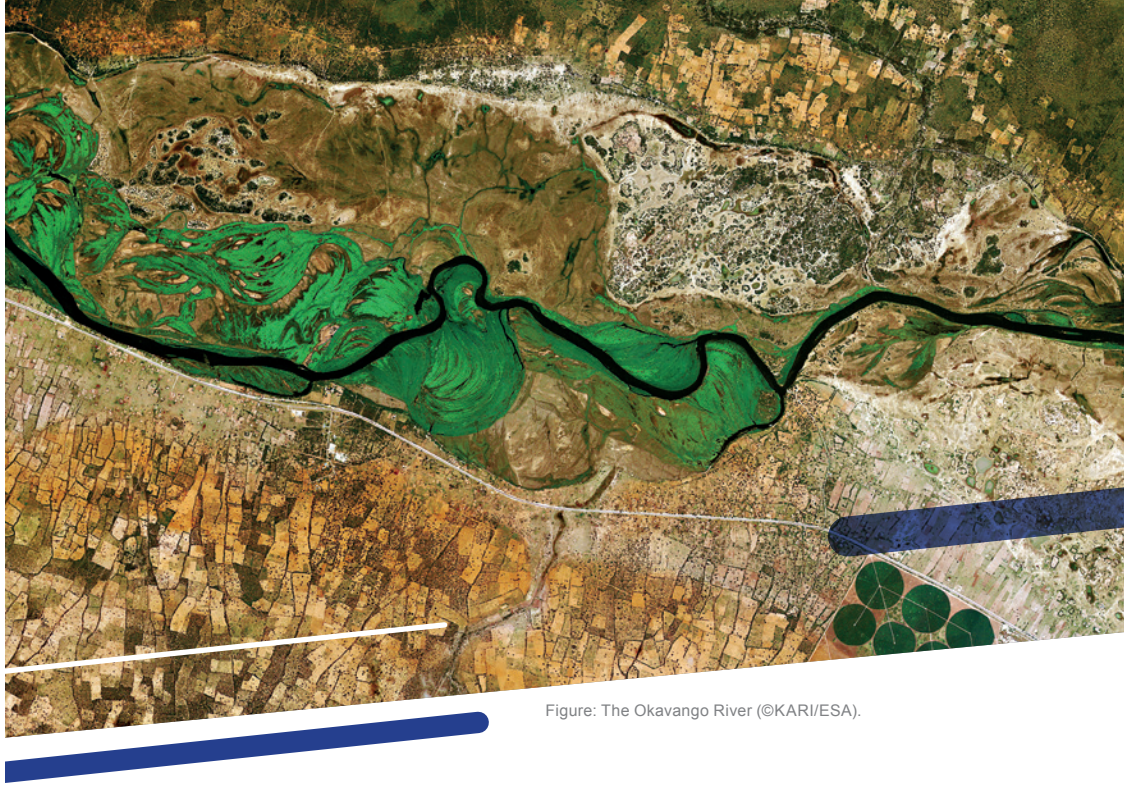

Figure: The Okavango River (©KARI/ESA).

Alongside the development of the Digital Learning Platform, the Working Group Africa was able to train around 20 African trainers, co-developed and implemented local training sessions in twelve African countries, and reached more than 1,300 trainees. All of the created Copernicus training materials, webinars, newsletters and presentations are available on the FPCUP website. The main beneficiaries of these results are researchers and universities, governmental bodies and local authorities, as well as private consultants.

Impact and Future Potential

One of the primary achievements of the action is the establishment of new partnerships with African entities and the reinforcement of capacities based on existing partnerships and collaborations between African and European entities. This collaborative approach among European partners has facilitated the exchange of knowledge, expertise and training resources between European and African experts.

At the moment no concrete opportunity to continue the activities has been identified. The main barrier to continue the activity is the complexity of funding schemes. However, there is a potential to reinforce the capacity of the African institutions,to expand the Digital Learning Platform including new training modules on business or technical aspects supporting the whole value chain of Copernicus data and services and thus to support the implementation of the new Africa-Europe space partnership programme. Continuity of activities and collaboration is essential to build sustainable Copernicus user uptake in Africa.

USER UPTAKE IN CENTRAL AND SOUTH AMERICA

General Information

- **Institutions:** Spanish Space Agency (AEE), Centre for Technological Development and Innovation (CDTI), Spanish Geographic Institute (IGN), Spanish National Centre for Geographic Information (CNIG), Hydraulics Environmental Institute – University of Cantabria (IHCantabria), Spanish National Institute for Aerospace Technology (INTA), Italian Institute for Environmental Protection and Research (ISPRA), Space Research Centre of the Polish Academy of Sciences (CBK PAN)
- **Running time:** 10/2022 – 10/2025
- **Primary topics:** Copernicus data, Copernicus in general, Copernicus user needs, emergency, land
- **Target users:** public sector (national, regional, local), private sector, research sector
- **Type of action:** national and multi national information/training events

Content and Results

This action aims to promote the user uptake of Copernicus data and services in Central and South America. Its main focus is on user uptake and expanding the Copernicus Relays network, with a practical approach towards regional issues such as: land and ground motion monitoring, natural and anthropogenic hazard assessment, and urban sprawl monitoring.

The main activities pursued have focused on coordinating all programmes and events, establishing a collaborative stakeholder network (CopLac) in Latin America, and promoting the adoption of Copernicus for land and ground motion monitoring. In addition, efforts have been made to promote the use of Copernicus data and its products in the region through workshops and training events on:

- Natural and anthropogenic hazard assessment
- Ecosystem vulnerability assessment
- Land and ground motion monitoring
- Urban sprawl monitoring

These activities aim to leverage the capabilities of Copernicus to support critical applications in Latin America, driving the effective use of its data and products to address regional challenges. Direct feedback from these events was collected to improve the Copernicus land and climate services.

Figure: Salar de Atacama, northern Chile. (© Contains modified Copernicus Sentinel-2 data (2017), processed by ESA.)

The primary outcomes of this action include the organisation of various thematic training events, workshops and webinars, the creation of communication material, content for the CDTI/CNIG webpage, and follow-up surveys of results and user uptake.

The main beneficiaries of the action's results are mainly government bodies, local authorities and researchers, as well as the private sector.

Impact and Future Potential

A mayor success of this action was the organisation of workshops and training events, which received overwhelming feedback from participants and sparked a strong interest in learning more about implementing Copernicus solutions. To build on this momentum, the Spanish Space Agency (AEE) intends to continue these activities with its own funding, as well as through partnerships with external European entities. This will enable the development of further events, reaching a broader audience and providing resources to new users eager to adopt and implement Copernicus technologies in their projects, municipalities, or academic pursuits.

Given the significant presence of Spanish speakers worldwide (approximately 600 million), promoting Copernicus user uptake in Spanish is a key priority, offering substantial opportunities for collaboration with the European Union and fostering new initiatives.

The potential for increased participation from diverse organisations, companies, governments, and universities will lead to new synergies and chances for innovative applications. By leveraging new communication channels, including social media and institutional platforms, we can develop creative solutions to expand the reach of campaigns and increase workshop attendance.

Furthermore, there is immense potential for exploiting Copernicus data and leveraging synergies with other elements of the European Space Programme. This will enable the development of new applications, driving innovation and growth in the region.

AUTOMATICALLY DETECTING NEW BUILDINGS – A PILOT PROJECT USING SENTINEL-1

General Information

- **Institution:** Norwegian Space Agency (NOSA)
- **Duration:** 04/2022 – 03/2023
- **Primary topics:** Copernicus user needs & land
- **Target users:** public sector
- **Type of action:** developing and piloting downstream applications and services

Content and Results

The aim of this action was to develop a service to find new buildings and automatically etect building changes, using Copernicus Sentinel-1 data.

The main activity of this action was to investigate the potential of using Sentinel-1 data for automatic change detection in the extent and shape of building polygons. A pilot project was conducted to clarify whether a fully operational service could be established. Algorithms for change detection were developed, and machine learning methods were explored.

The main outcomes were algorithms for automated detection of building changes, including appearance and disappearance of buildings. It was verified that there is potential for map products that can be cost-effective for relevant authorities and ease the task of building construction mapping and administration for municipalities and other government bodies in Norway.

Building detection algorithms based on Copernicus Sentinel-1 data were developed and are openly available for further testing at https://gitlab.norceresearch.no/earth-observation-public/senbygg

The main beneficiaries of the action's results are government bodies such as the Mapping Authority and the Centres for Work-related Crime, as well as local authorities, especially municipalities.

Impact and Future Potential

Particularly successful were the algorithms for automated detection of building changes, including appearance and disappearance. The algorithms tested and developed in the project, based on averaged Sentinel-1 backscatter data and studies of machine learning applications, provide a valuable knowledge base and may be developed by incorporating higher-resolution or more accurate ground-truth data.

Building on this action, the Norwegian Mapping Authority (NMA), together with NOSA, the Norwegian Research Centre (NORCE) and the Norwegian Centres for Work-related Crime, developed operational tools to detect the onset of building activities, making it possible for authorities to carry out more timely inspections.

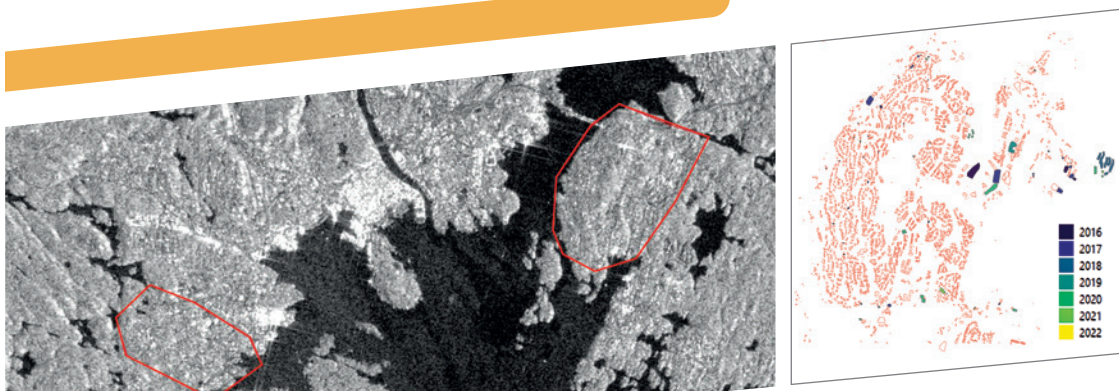

Figure: Sentinel-1A SAR data over Norway (© Copernicus), with the two study areas in Kristiansand Municipality highlighted. The right insert shows an example of detectable building changes as they occured by year in the data set spanning all aquisitions from 2016 to 2022 (© Norwegian Mapping Authority (NMA)).

AGROMETEOROLOGICAL MODELLING BASED ON COPERNICUS REGIONAL REANALYSIS DATA

General Information

- **Institution:** German Meteorological Office (DWD)
- **Running time:** 04/2022 – 10/2025
- **Primary topic:** climate change
- **Target users:** general public, research sector
- **Type of action:** developing and piloting downstream applications and services

Content and Results

This action focused on investigating and establishing the Europe-wide application of the agro-meteorological model AMBAV (by DWD), using Copernicus reanalysis data as a meteorological driver. The primary outcome of this action is a comprehensive set of graphics of visualising long-term changes in water availability across Europe, to serve as informational basis for adaption strategies in agriculture.

The project is based on the adaption of the model to a Europe-wide application and the evaluation of its performance. The resulting dataset was used to analyse dynamics of water availability in the agricultural context with respect to climate change. A compilation of products will visualise the findings and underlying data, making them easily accessible to a variety of users. The products will be published on a DWD web portal accompanied by related information on the topic.

Our main outcome is the creation of a Europe-wide dataset of daily soil moisture and other variables spanning approximately 60 years. Furthermore, a study on the performance of AMBAV at sites in Central-Europe, using data from the Integrated Carbon Observation System (ICOS), was conducted. A contribution to a special issue on the practical use of evaporation data by the DWA (German Association for Water, Wastewater and Waste), as well as the visualisation and publication of agro-meteorological indices on a DWD web portal, are further important objectives of the project.

First results of the action were already presented at various scientific conferences. Further presentations and publications are planned. Users of the DWD's advisory service will benefit from the information gathered. In addition, the action's products will contribute to the public and scientific awareness of climate change effects on agricultural systems in Europe.

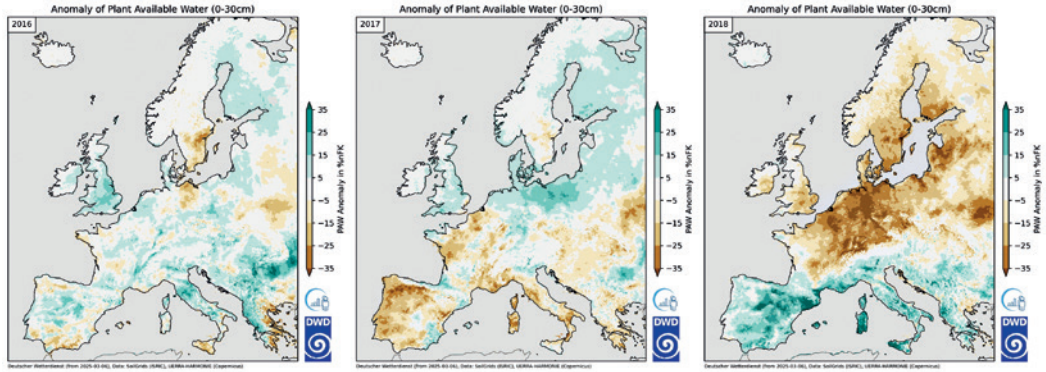

Figure: Yearly average of plant available water (PAW) in the top soil (0-30 cm) under grass compared to the 1981–2010 reference period. The maps visualise the results of simulations with the soil-vegetation-atmosphere model AMBAV, developed at the DWD. (© DWD)

Impact and Future Potential

The study of AMBAV model performance across the Europe-wide domain is one of the most important achievements of this action, as it forms the basis for future development and applications of the model.

Due to a lack of funding, it is currently not possible to continue the action's activities or to work on more specialised applications, or on the further development of the products based on user feedback. Nevertheless, learnings and results acquired through this action, concerning model application and the communication of findings, will still inform future routine operations at DWD.

There is, however, potential for a wider application and innovation. The action encourages further development of the AMBAV model towards Europe-wide applications, such as forecasting. Soil moisture is an important input variable for broad applications in agricultural management (e.g. irrigation needs, accessibility) and food security, as well as for the prediction of soil-borne greenhouse gas emissions. Therefore, this information is valuable for various adaptation measures to climate change.

CULTURAL HERITAGE TECHNICAL GROUP

General Information

- **Institutions:** Italian Institute for Environmental Protection and Research (ISPRA), German Aerospace Center (DLR), Cyprus University of Technology (CUT), National Observatory of Athens (NOA), PRAXI Network/Foundation for Research and Technology – Hellas (PRAXI Network/FORTH)
- **Running time:** 03/2023 – 09/2025
- **Primary topics:** climate change, Copernicus in general, Copernicus user needs, cultural heritage
- **Target users:** public sector (national), general public, private sector, research sector, universities
- **Type of action:** developing and piloting downstream applications and services

Figure: Gulf of Taranto, Italy. (©contains modified Copernicus Sentinel-2 data (2019), processed by ESA.)

Content and Results

The main goal of this action was to establish the Cultural Heritage Copernicus Technical Group (CHCTG), representing a European user network in the specific field of Natural and Cultural Heritage (NCH) conservation, management, and sustainable exploitation. The group aims to define and demonstrate Copernicus products and services for NCH, facilitating broad exchanges on their development and use across Europe.

The organisation of technical meetings, information sessions, training, networking events and opportunities were among the main activities undertaken during the action. Furthermore, activities focused on increasing the uptake of Copernicus data, services, and products by users within the European natural and cultural heritage community.

Primary outcomes included the creation of a stable and large natural and cultural heritage community at European level, by promoting actions of capacity-building, awareness, and uptake at different levels and for different skills and needs.

The main beneficiaries of these results are various communities (from local to pan-European to global level) active in the field of monitoring and protecting cultural heritage from natural and anthropogenic risks, amplified by the effects of climate change.

Impact and Future Potential

One of the key successes of this action is the significant interest and engagement of all participants in the various organised events, which has led to the inclusion of a thematic hub on European cultural and natural heritage within the Copernicus programme. This hub is currently under development.

The potential for this action to be extended is substantial. As one of the main funding themes of European research programmes, such as Horizon and JPI, it represents a promising area for future innovation and technological development. The scope for wider application and innovation is also vast. As the introduction of new national contributing missions by member states, equipped with advanced satellites, sensors, and data acquisition capabilities, as well as the forthcoming evolutions of the Copernicus missions, will create new challenges and opportunities for applications and technological innovations in the field of cultural heritage. This will further position Europe as a central hub for strategic sectors, such as the sustainable exploitation of cultural tourism.

CUP4SOIL – HIGH-RESOLUTION SOIL PROPERTY SERVICE DEVELOPMENT FOR NATIONAL AND EUROPEAN SOIL CARBON REPORTING

General Information

- **Institution:** German Aerospace Center (DLR)
- **Running time:** 04/2022 – 10/2025
- **Primary topic:** land
- **Target users:** public sector (local, regional, national), private sector, research sector
- **Type of action:** developing and piloting downstream applications and services

Content and Results

CUP4SOIL aims to develop high-resolution image data products for the Copernicus Land Monitoring Service (CLMS) applicable to characterise and monitor the European soils. Thus, it will support national and European agencies in reporting on soil health. Within the project, European-wide data products for spectral and statistical characterisation of soils, as well as the physical and chemical properties of soils, are being provided. This information is derived from the Sentinel-2 archive and enables the user community to test and validate this information for soil health and quality monitoring.

CUP4SOIL explores literature and project resources to gain an update on the current discussion of essential soil health descriptors. This will be collected in the first version of a User Requirement Document, including the results of a user survey.
CUP4SOIL further generates European-wide soil information products based on Sentinel-1 and Sentinel-2 data. For this purpose, DLR and ISRIC – World Soil Information combine their large-scale processing expertise and facilities. DLR is creating several soil-related input products, such as soil reflectance composites, information on soil cover frequency, and the vegetation dynamic at high spatial resolution (20 m). These data products feed into ISRIC's high-performance computing environment, which generates information on soil organic carbon (SOC) content, texture pH values, and more, using digital soil modelling approaches. The data will be made publicly available. Selected key users are involved in evaluating the usability of the proposed soil information products in so-called showcases. It is also planned to compare the CUP4SOIL products with other existing European-wide soil products.

Figure: SoilSuite Europe – 5-year composites from Sentinel-2. (©DLR. Contains modified Copernicus Sentinel-2 data (2018-2022).)

One of the primary outcomes of CUP4SOIL is a user survey which provides insights into the requirements of a broad user community. The majority of users point to a lack of soil-specific data products in the current CLMS, especially SOC, texture, and bulk density, including uncertainty measures for each parameter. The recently published SoilSuite Europe, an image data package characterising the spectral and statistical properties of soils, has already been used as input for various user service tests, such as the derivation of SOC content and stocks, the monitoring of regenerative agriculture, and the observation of bare soil occurrences to define grassland areas for Germany. SoilSuite is available for the public on a free and open basis. The main beneficiaries of these results are governmental bodies, local, regional, national and European authorities, as well as private companies and researchers.

Impact and Future Potential

The cooperation with ISRIC was highly successful, providing a large network of users in all beneficiary types and enabling the collection of user requirements across Europe. Furthermore, DLR Terrabyte – a flexible HPC platform for product development and testing –, an efficient programming as contribution to resource efficient processing, and deep knowledge for digital soil mapping enabled the creation of 20 m spatial resolution data products and proved to be highly successful components of this action.

At the moment, no concrete action has been initiated to continue the activity on European level. However, the concept could be successfully transferred to three African countries – Rwanda, Kenya and Ethiopia to provide soil and agricultural information following the FAIR principles. Furthermore, there is a high potential to enhance the SoilSuite methodology through the use of operational hyperspectral satellites and deep learning, for (1) improving higher accuracy of the soil spectral information and (2) enabling the large-scale provision of such data based on physical principles. Owing to intensive exchange with the user community, demands for new data products from Earth Observation data, such as bare soil dates and yearly to seasonal products, as input for the soil erosion monitoring and for monitoring regenerative agriculture, have been urgently requested.

DOWNSTREAM SERVICE AND APPLICATION DEVELOPMENT TO SUPPORT IMPLEMENTATION OF THE EU WATER FRAMEWORK DIRECTIVE IN ESTONIA

General Information

- **Institution:** Tartu Observatory of University of Tartu (TO)
- **Running time:** 09/2020 – 09/2023
- **Primary topics:** Copernicus user needs, marine
- **Target users:** public sector (national and regional), research sector
- **Type of action:** developing and piloting downstream applications and services

Content and Results

In this action, data from Copernicus Sentinel-3/OLCI and Sentinel-2/MSI are used to develop a prototype of downstream application for Estonia's large lakes. For the inland waters, existing products are not sufficiently accurate. Case-specific algorithms needed to be developed to estimate the lakes' ecological status class according to the Water Framework Directive requirements, based on phytoplankton and transparency.

A prototype of downstream application was successfully developed, and is still operational. It was introduced to the representatives of the Estonian Environment Agency and the Estonian Ministry of Environment, who gave a feedback during and after the project, suggesting potential improvements and additional features.

The primary outcomes are a downstream application (fpcup.to.ee) enabling the download of satellite data to visualise seasonal and spatial dynamics of chlorophyll-a and transparency for larger lakes in Estonia, along with the estimations of ecological quality status according to the Water Framework Directive criteria for specific parameters. The application includes data about the period 2016 to the present. The downstream application was demonstrated as the Estonian use case at the GREENET webinar on Copernicus and Galileo (April 2023). The main beneficiaries of these results are governmental bodies, environmental agencies, researchers, students and schoolchildren.

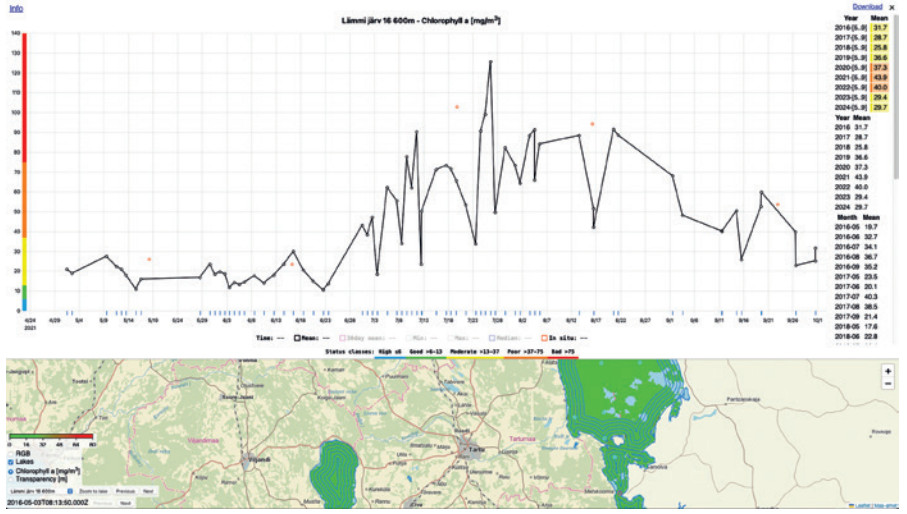

Figure: Example of the prototype downstream application. Visualisation of seasonal and spatial dynamics of chlorophyll-a. (© TO, contains Copernicus Sentinel data, background by Leaflet, Estonian Land and Spatial Board.)

Feedback from the Estonian Environment Agency:

"The application offers many benefits […] and can help us detect patterns in lake health, including algal blooms and eutrophication."

Feedback from the Estonian Environment Agency: "The application offers many benefits […] and can help me detect patterns in lake health, including algal blooms and eutrophication."

Impact and Future Potential

One of the greatest successes of this action is evident in the fact that government officials are increasingly aware of the possibilities and limitations of satellite data, and there is growing interest in using such data in their work. Enhanced cooperation with Estonia Environment Agency was maintained from the very beginning through to the final comments on the end-product.

ESTIMATION OF SNOW LOAD DATA USING COPERNICUS AND IN-SITU DATA

General Information

- **Institutions:** German Meteorological Office (DWD), Centre National de la Recherche Scientifique (CNRS),Finnish Meteorological Institute (FMI)
- **Running time:** 10/2022 – 10/2025
- **Primary topics:** Copernicus data, Copernicus user needs, land
- **Target users:** public sector (national, regional, local), general public, private sector
- **Type of action:** developing and piloting downstream applications and services

Content and Results

The main objective of the action is the development of a Copernicus Climate Change Service (C3S) application on the Climate Data Store (CDS), enabling Europe-wide provision of snow load climatological information for civil engineering, as well as hazard and damage prevention purposes. Three pilot downstream services in Germany, Finland and Italy will link the data from the C3S application to regional snow load information.

The main activities of this action include the development of a prototype of a C3S-CDS snow load application that provides Europe-wide snow load information, both for current and future climate scenarios. In addition, a prototype of a pilot downstream service in Bavaria (second version) was developed, and several user questionnaires and workshops were conducted to gather user needs and feedback. The primary outcomes include the development of the C3S-CDS snow load application for Europe-wide snow load information, as well as a pilot downstream services in Germany, Finland and Italy. Further, studies were conducted on the reanalysis of snow data and on theestimation of extreme values under climate change (with papers forthcoming).

The main beneficiaries of these results are local authorities, disaster agencies, and public and private civil engineering companies.

A member of a federal civil and disaster protection organisation, deployed when public buildings are threatened by snow loads on their roofs, has stated: This demontrates the impact that the application is already having on users and potential target groups.

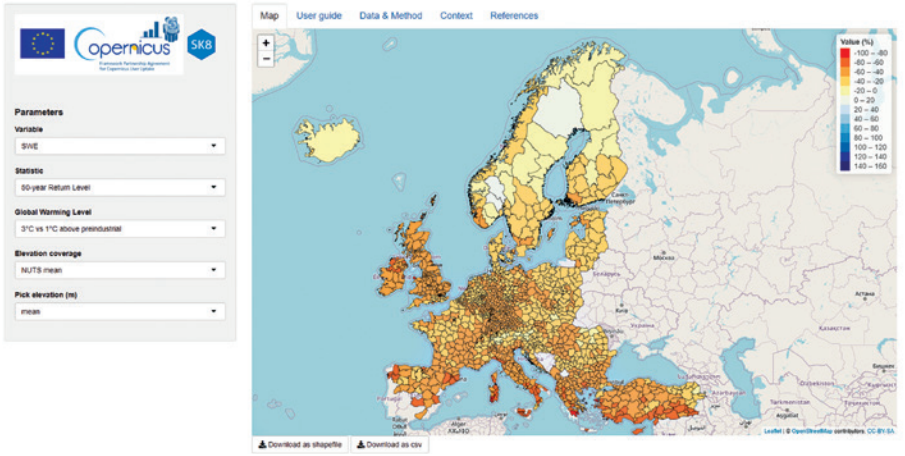

Figure: Screenshot of the prototype of the FPCUP SNOWLOADS C3S app. Developed by Samuel Morin, Elisa Kamir, and Guillaume Evin (CNRS), hosted on INRAE servers.

Feedback from the German Federal Agency for Technical Relief (THW):

"The snow load information system allows us to determine the main areas of operation online and plan the operation in advance. The snow load information system provides an excellent support tool for our effective and resource-saving operational planning."

Impact and Future Potential

The use of CDS reanalysis to create a Europe-wide dataset of snow indicators has been very successful. The user workshops (both online and in person) were highly effective, and the dialogue with stakeholders was very fruitful in both directions.

There is potential to build on these achievements by continuing the development of the application (enrichment with more snow-related datasets, for instance) and expanding the regional pilot downstream services into larger regions with full operational implementation. The funding for this is, however, uncertain at the moment..

The C3S-CDS application offers great potential for a wider field, it has been developed to incorporate additional snow-related datasets and statistics. Hence, from further development more user-related benefits can emerge. Pilot downstream services are essentially ready to be expanded into larger regions with full operational implementation.

REMOTE SENSING OF SNOW WETNESS (WETSNOW)

General Information

- **Institutions:** Norwegian Space Agency (NOSA), Romanian National Meteorological Administration (MeteoRomania)
- **Running time:** 09/2022 – 12/2023
- **Primary topics:** Copernicus data, Copernicus user needs and land
- **Target users:** public sector (national, regional and local), private sector, research sector
- **Type of action:** developing and piloting downstream applications and services & national and multinational information/training events

Content and Results

The main objective of this action was to operationalise optical and multi-sensor algorithms to estimate wet snow based on Sentinel-1 and Sentinel-3 data, building on previously developed methods. One of the main activities undertaken was the full calibration of algorithms using data from 2017 to 2020, the extensive validation of the algorithms in Norway and Romania, and the implementation of an operational processing chain made available to governmental organisations.

The project identified the requirements and specified a processing chain and a service for snow wetness products to be developed within the action. The processing chain was created to be fully automated, downloading Level-1B input satellite data and generating snow maps according to a defined product standard. The system runs on a hosted online platform that provides system resources as well as large repositories of EO resources. This includes software repositories and deployment services, workflow configurations, and implementations for ingestion service. The action also carried out calibration and validation activities with in-situ measurements of snow wetness at the Valdresflya test site in Jotunheimen, applied by NR over a 25-year period. The action finally launched the results as two independent pilot services, one in Norway and one in Romania.

Link to the Norwegian service web portal: https://snowlab.nr.no/wetsnow
Link to the Romanian service web portal: https://www.wetsnow.ro

The main beneficiaries of these results are public institutions, which were the target user group of the action and are already utilising the services. In Romania, the Ministry of the Environment and the Institute of Hydrology and Water Management are using the pilot products in their models. In Norway, the wet snow products may be useful in further development of the Norwegian national snow and ice services. As expected, the services developed in Wet Snow, although still in pilot form, have great potential to improve warning services. The results of the action also show potential for application in other alpine regions of Europe and globally.

Figure: Scandinavian Peninsula, March 2022.
(© contains modified Copernicus Sentinel-3 data (2022), processed by ESA.)

Impact and Future Potential

One of the most successful parts of the action was the outreach carried out in autumn 2023, which created a significant engagement for such a specific product. Ideas for involving more countries beyond Norway and Romania materialised during that time. The project arranged a special session at the HydroSpace Conference in Lisbon in November 2023 with over 30 participants, both on site and online. At this demonstration event, the services and technical aspects were presented. The scientific results were successful in two very different mountain regions (Norway and Romania: different topographies different climate zones). The applications readiness levels are high, but the application still requires additional resources and further investments to run more calibrations in order to cover seasonality and climate variations, and to develop and maintain a near-real-time or forecasting product for the future.

There are opportunities for further funding, for example, in relation with service development and cal/val, but currently no funds are available. There are, however, ongoing related activities in both Norway and Romania. The application has potential for upscaling and to be operated in other mountainous and snowy regions worldwide, as well as forming snow wetness products with value both for calibration/validation, research, and flood/avalanche warning systems.

TAILORED DOWNSTREAM APPLICATIONS AND PRODUCTS – FROM COPERNICUS TO COASTAL AND INLAND WATER MONITORING

General Information

- **Institutions:** Tartu Observatory of University of Tartu (TO), Finnish Environment Institute (Syke)
- **Running time:** 10/2022 – 09/2025
- **Primary topics:** Copernicus data, land, marine
- **Target users:** public sector (national, regional, local), research sector
- **Type of action:** developing and piloting downstream applications and services, national and multi national information/training events

Content and Results

The main objective of this action is to promote the use of Copernicus data for advancing the monitoring of coastal and inland waters. High- and medium-resolution multi-sensor data (Sentinel-2A and -2B MSI, Sentinel-3A and -3B OLCI, and Landsat-8 & Landsat-9 OLI) was used for enhancing the inclusion of the EO products into the reporting chain for fulfilling the status assessment requirements of Water Framework Directive between Finland and Estonia.

Both national and multinational information/training events were held, where the existing and potential new Copernicus-based water quality products for coastal and lake areas were presented. Based on user interaction and specifications, the most feasible new downstream products were developed.

Four products have been created by TO, including a phytoplankton bloom product for large Lake Peipsi from Sentinel-3 data, a water colour product based on the Hue Angle approach and Sentinel-2 data, and CDOM and transparency products based on Sentinel-2 data. New products have also been developed by Syke, including a turbidity product, flood area estimate product based on Normalised Difference Water Index (NDWI), a high-resolution daily Landsat (HRLC) water temperature product, and water temperature composites for Sentinel-3 SLSTR. The NDWI product, HR Landsat temperature product and SLSTR temperature composites are part of operational daily data processing and are published in Syke's web map service Tarkka (tarkka.syke.fi). Furthermore, TO has created teaching materials in English and Estonian on phytoplankton bloom mapping, and a publication on bloom dynamics in shallow lakes has been published.

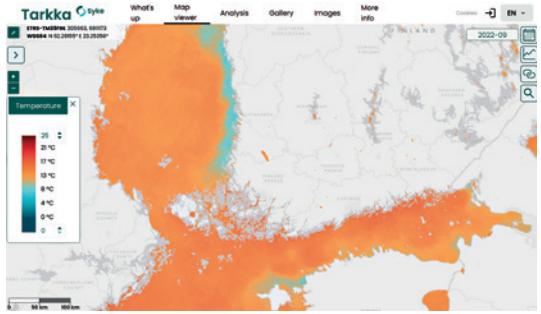

Figure: Aggregated monthly (September 2022) mean water temperatures in the Baltic Sea based on Sentinel-3 SLSTR observations visualised in Syke's web map service Tarkka (Tarkka.syke.fi). The cold temperatures along the western coast of Finland and near Estonia are due to upwelling.
(© Syke data, contains modified Copernicus Sentinel data (2024), Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community)

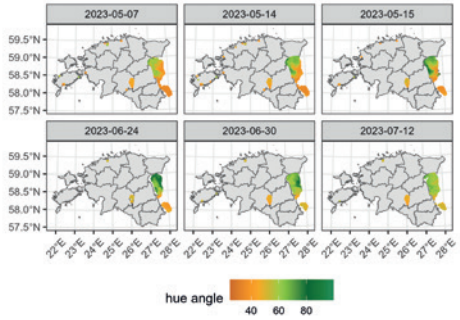

Figure: Water colour product maps, derived from Hue Angle – seasonal variations in lakes during spring and summer.
(© University of Tartu, contains Copernicus Sentinel-3 data.)

The main beneficiaries of these results are researchers, environmental institutions, government bodies, and the general public.

Impact and Future Potential

One of the greatest successes of this action was the acknowledgement for the usefulness of the created products and Copernicus data by the relevant users, as well as the positive feedback on the multinational training events.
At Syke, the developed products are now part of the operational daily data production. The processing steps are mostly automated, requiring only low maintenance effort covered by Syke's operational activities.
In Estonia, there is potential to extend these products from inland to coastal waters. In Finland, the development of the Tarkka service is an ongoing activity. New Copernicus-based products are constantly being added to the service. The analysis of Tarkka users will support further development the service in the future. There is a great possibility to continue activities regarding phytoplankton blooms and Water Framework Directive (WFD) reporting in the future.

#EU Space
COPERNICUS USER UPTAKE

THE ROLE OF FPCUP – CONCLUSION AND LESSONS LEARNT

The FPCUP project represents a vital initiative to bring forward the realisation of the full potential of Copernicus across Europe and beyond. What distinguishes FPCUP from other funding opportunities was its approach to user uptake: unlike other measures, it followed a **bottom-up approach,** empowering national and local stakeholders to define their own priorities and propose solutions tailored to their needs.

At the beginning of the project, some of the consortium partners were at very different stages of Copernicus user uptake. With the support of FPCUP, many activities could be realised at national level, developing individual solutions based on the national needs and the institutional structures of each member state. **Learning from each other** has contributed to the use of Copernicus in the various partner organisations and their countries.

It is not only in this respect that the FPCUP network and the resulting **cooperation between the countries** is one of the key achievements of the initiative. While the early work programmes primarily promoted smaller, nationally oriented actions with one or a few partners, larger, multi-partner actions with a wider geographical scope were developed in later phases. These included European cross-border projects, as well as international cooperation in regions such as Africa, Central and South America, and Asia. These larger actions often had a greater impact, both in terms of innovation and in reaching new user groups.

Another key lesson learned is the **importance of patience.** Building trust and demonstrating the potential value of previously unfamiliar data takes time, particularly with public authorities that were initially uncertain about how Copernicus could support their specific tasks and mandates. Success was based on co-developing practical, ready-to-use products tailored to individual needs and proving the relevance of Copernicus in concrete applications. Altogether, Copernicus user uptake is a process that requires time, a lot of communication and sometimes even trial and error before a high level of maturity is reached.

Another important factor in FPCUP's success was not simply what was funded, but how. While "classic" user uptake measures, such as trainings, dialogue formats, and promotional events, will always be valuable, the exchange of experience between actions prevented duplication of work and led to best practices.

FPCUP's flexible framework successfully balanced top-down coordination and bottom-up initiative, enabling both targeted strategic alignment and grassroots innovation — a model that has proven effective for future user uptake instruments.

Over seven years, the FPCUP initiative has demonstrated the vital role that the EU member states play in advancing Copernicus user uptake across Europe. Thanks to its bottom-up structure and a broad consortium composed of 50 partners from 23 countries, the programme has been highly effective in capturing national and regional user needs, and translating them into meaningful, demand-driven activities.

FPCUP has proven to be an effective instrument for raising awareness, capacity, and user acceptance of Copernicus at national, regional and even international levels. Its integrative approach made it possible to address a wide range of disciplines and application scales.

A key strength of the programme lies in its ability to foster community-building and awareness, **extending down to the local level.** Many of the 220 funded actions helped establish or strengthen national networks and local dialogues with users. Capacities were built where they were most needed. At the same time, innovative actions helped to extend the reach of Copernicus by engaging new user groups, exploring emerging topics, and experimenting with new communication and training formats.

FPCUP has laid a strong foundation for the continued success of Copernicus user uptake and serves as a valuable model for future user uptake measures. Its results demonstrate the power of combining national initiative with European cooperation — an approach that would be worth continuing in future funding instruments and policy strategies for Copernicus and the utilisation of Earth Observation.

ACKNOWLEDGEMENT

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Figure: launch of the Copernicus Sentinel-2C satellite
(© ESA–S. Corvaja (2024))

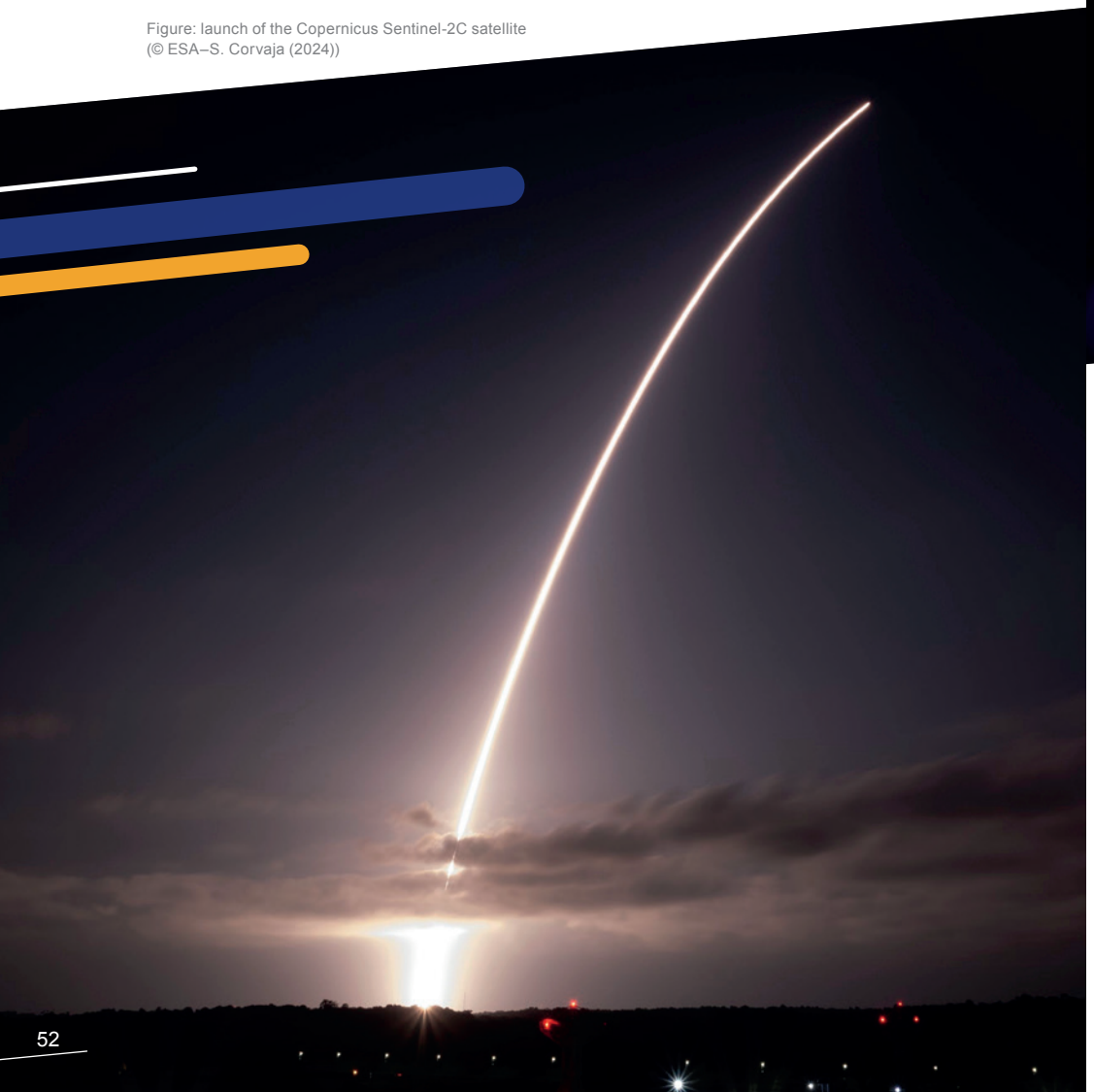

Figure: Fogo Island, Cape Verde.
(February 2025 © European Union,
Copernicus Sentinel-2 imagery.)

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Credit: contains modified Copernicus Sentinel data (2017), processed by Sinergise/ESA.

Image back cover: Wadden Sea, Germany.
Credit: European Union, Copernicus Sentinel-2 imagery.

SEVEN YEARS OF COPERNICUS USER UPTAKE THROUGH FPCUP

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