EuroGEO

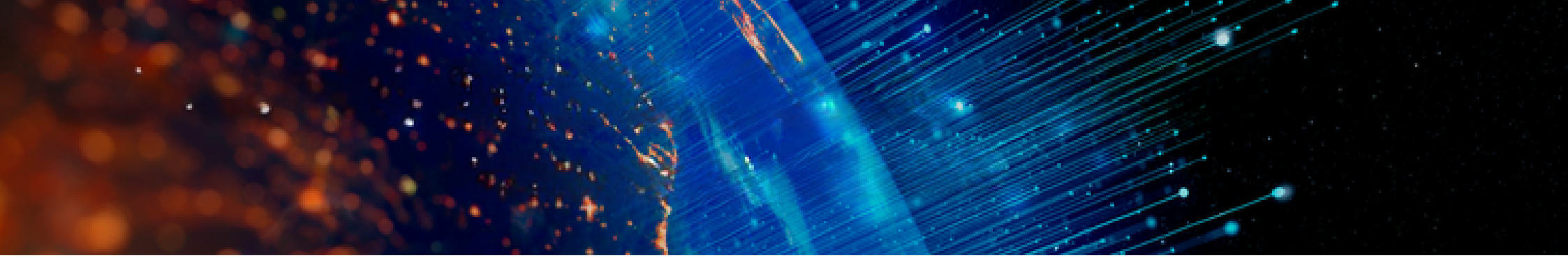
DISASTER RESILIENCE AND HEALTH

Analysing the pattern dynamics in Earth Observation Research & Innovation

#OneEuroGEO

COMBINE, COORDINATE, COOPERATE

Table of Contents



Introduction

In recent years, there has been an **increasing uptake of Earth Observation** (EO) as a tool in support of the implementation of various policies and the execution of a wide range of operational tasks. Users across the value chains of different sectors can utilise EO-based solutions in support of their work, **realising significant benefits** (economic, environmental, societal, etc.). Market demand for such solutions is driven by policies and sector-specific needs. Technological advances have the potential to enable solutions that match the specific needs.

EuroGEO, Europe's part of the Group on Earth Observation, stands at the intersection of research, policy, and markets. This **strategic position** allows it to identify and monitor relevant developments and trends, to engage stakeholders, and to assess the evolving EO landscape in Europe and beyond. Capturing insights relevant for the different stakeholders allows EuroGEO to document the current state of play of EO, its trajectory, and the required steps for broader adoption and increased benefits.

With the support of the ***EuroGEOSec*** **project**, and with the aim of **maximising the impact of Research and Innovation** (R&I), a dedicated effort has been made to establish the **R&I Observatory for Earth Observation** (RIO). This includes a team of analysts and an online tool to monitor and analyse past and ongoing R&I in EO in order to identify trends and support strategic decisions on future R&I activities. Relying on the RIO, the so-called **R&I State-of-Play Reports** are created presenting a concise overview of the policy context, technological perspectives, and market trends within the thematic areas covered by the **EuroGEO Action Groups** (AG). This present report focuses on analysing patterns in the **Disaster Resilience and Health (DH) segment**. Research has been complemented by multiple other reports and studies, including studies performed by and for EuroGEO's Disaster Resilience and Health AG.

The aim of this report is to **support EuroGEO and its stakeholders in decision-making** regarding future work programmes and strategic innovation agendas (such as those of the Knowledge Centre on Earth Observation – KCEO), inform the review of the **EuroGEO Implementation Plan**, and contribute to the production of institutional outputs.

The following EuroGEO **Action Groups** develop application pilots/conduct other actions foreseen in the EuroGEO roadmap: Agriculture, Land Cover and Land Intelligence (LC&LI), Urban, Disaster Resilience and Health, Energy, Biodiversity, ecosystems and geodiversity (BEG), Marine, Climate, and Green Deal Data Spaces.

Methodology

The browser-based tool of the **R&I Observatory for Earth Observation** (RIO) allows retrieving relevant information from a variety of sources, including project information (e.g., descriptions, partners, budgets, results, timelines) for the majority of relevant European R&I programmes. Sources include information related to e.g., Horizon Europe (HE) and its predecessors, the LIFE programme, the Connecting Europe Facility, Eurostars, COSME, the European Defence Fund, and the European Defence Industrial Development Programme. Additional sources are being incorporated as part of the continuous development of the RIO.

The RIO structures the information into a standardised format for the uniform documentation of R&I activities. Functions of search, bookmarking, filtering, visualisation, and export allow the processing and analysis of the pre-curated information.

The focus of the analysis is on **mapping R&I efforts across segments** by analysing data on projects, core applications, budgets, and timelines. The full list of the analysed projects, filtered from the database of projects and mapped against segment-specific EO applications can be found in the original deliverable 🔗 . The segment's **core applications** have been identified and mapped based on the most prominent and important themes, as determined by the Action Group and tits leads. They are derived from **AG expert studies** 🔗 and further validated by sector experts such as AG leads. See the classification below:

- Disaster Risk & Event Monitoring
- Emergency Response & Crisis Management
- Health Risk Surveillance
- Urban & Infrastructure Resilience
- Exposure, Vulnerability & Impact Analysis

To address the research questions – i.e., to identify trends in EO-related R&I for DH applications and the drivers behind them – the following **limitations or simplifications** were applied:

Data Processing

- Project information sourced from the RIO (including acronym, title, coordinators, topic, programme, pillar, objectives, work programme, status, start and end dates, budget, grant, and links) has been filtered using segment-specific keywords to ensure that only relevant projects are included and no projects are overlooked. This relies on full-text search in existing descriptions and meta data, along with the use of consistent terminology. Where data might be missing or unexpected terminology is used, certain projects may have been missed.
- The filtered list of projects considered relevant has been extracted (i.e., exported into a spreadsheet) for processing.
- Data has been manually checked for relevance and further cleaned accordingly, then augmented by segment-specific categorisation for more detailed analysis.

Methodology

Timeframe

In order to restrict the analysis to relevant activities while drawing from a significant enough sample size, a (roughly) **10-year timeframe** is used, covering the period **from 2014 to 2024** (i.e., only projects that have started before 2025 and have not ended before 2014 have been analysed). This timeframe is used to capture long-term trends, technological developments, and measurable outcomes of concluded projects. It also ensures that typical project lifecycles, such as those in Horizon Europe, are included. It coincides with the launch of the first Sentinel-1 satellite in 2014, the free and open data of Copernicus being considered as one driver of EO-related R&I, which has been attempted to confirm through the analysis.

Sample Size

The sample data is limited to the sources **currently included in the RIO**, expected to cover relevant European R&I projects to a large extent, but with further potentially relevant projects not included in the analysis where the data source has not been included yet. It is further limited to the keywords and queries applied (see data processing above) and timeframe selected (see timeframe above).

Budget allocations per application

Breaking down budgets of projects that address more than one segment-specific application and dividing them across these applications has been done following a simplified approach assuming an (unlikely) even distribution. Therefore, budget sizes per application can only **reflect trends** and may not be fully accurate.

To interpret and complement the findings from the RIO tool, **desk research** has been conducted across reports and studies, including:

- European Space Agency (ESA) application or industry articles
- European Commission (EC) documents, e.g., Climate factsheets, Reports on uptake barriers of EU space services
- EUSPA EO and Global Navigation Satellite System (GNSS) 2024 Market Report
- Stocktaking Reports from related Group on Earth Observations (GEO) initiatives
- Horizon Europe's Strategic Research and Innovation Agendas
- Segment-specific as well as EO-related strategic research and innovation agendas including outcomes of the Horizon 2020 (H2020) project *FIRE*
- EuroGEO Workshop Reports
- **EuroGEO Disaster Resilience and Health Expert Studies**

These **sources** were carefully reviewed to extract relevant content that addressed the questions raised during the analysis. They were particularly useful in identifying gaps and barriers in each segment, as well as R&I trends and technologies that are (or can be) applied to address these issues.

DH Overview

Humanitarian emergencies are increasingly driven by **climate change**, which fuels a rise in the occurrence, size, and severity of extreme events like heatwaves, wildfires, floods, and powerful storms.1 In Europe, inundation is one of the major natural hazards.

According to the EM-DAT database, **2024** recorded **393 natural hazard disasters**, causing **16,753 deaths** and affecting **167.2 million people** worldwide. **Europe** accounted for **24 events**. These figures highlight the urgent need for stronger disaster resilience at regional and global levels. Earth Observation (EO) services can support this by strengthening prevention, preparedness, response and recovery.

The World Health Organization (WHO) calls climate change the **greatest threat to human health**, with largely negative effects on populations. Growing evidence, including IPCC assessments, shows it heightens global health risks, affecting both emergencies and long-term conditions. It is driving the spread of **diseases into new areas** and **altering** patterns of food-, water- and vector-borne **illness**. As warming continues, risks from heatwaves, fires, undernutrition and disease outbreaks are expected to rise. Climate-sensitive infectious diseases – particularly vector-borne ones such as malaria, dengue, leishmaniasis and yellow fever – cause over **700,000 deaths** a year and make up more than 17% of infectious diseases, with transmission shaped by environmental change. Water-borne diseases like cholera and schistosomiasis show similar trends, increasing global health burdens.

To meet these challenges, many EU countries are strengthening health systems through enhanced infectious disease surveillance, environmental health programmes and early warning systems. Effective control and prevention now require **proactive action**, better **early warning tools** and innovative adaptation strategies.

EO supports health systems and services by monitoring environments, helping control outbreaks, managing extreme weather, and improving understanding of how ecosystems affect human health.

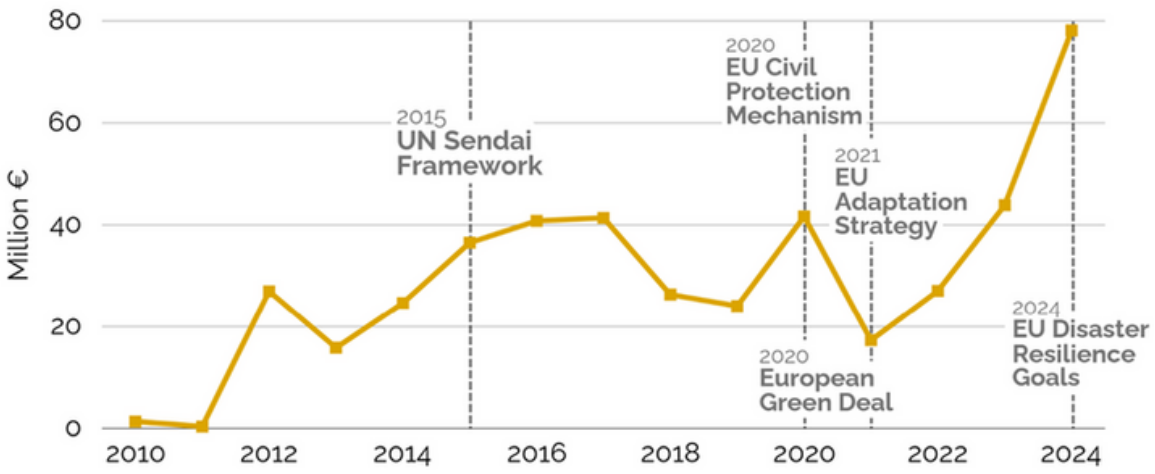
EuroGEO tackles these challenges through its **Disaster Resilience and Health Action Group (DH-AG)** and ongoing analysis of market, technology, policy and R&I trends. DH-AG advances EO use in disaster and health by developing scalable, user-focused services, strengthening early warning systems, and supporting R&I that combines satellite and in situ data for preparedness and response. By working with stakeholders, promoting open data and piloting innovations – such as digital twins and AI-based health risk models – it turns policy aims into practical, evidence-based solutions, encouraging co-design and nature-based approaches.

Aligned with DH-AG goals, this report reviews EO research and innovation for disaster and health, alongside relevant policy, technology and market trends. It focuses on Disaster Risk and Event Monitoring, Emergency Response and Crisis Management, Health Risk Surveillance, Urban and Infrastructure Resilience, and Exposure, Vulnerability and Impact Analysis.

Policy Context

EO is increasingly recognised as a key enabler for major European and global policy initiatives in disaster risk reduction and health. The **Sendai Framework for Disaster Risk Reduction** (2015–2030) and the UN Sustainable Development Goals (**SDGs**) both emphasise the role of EO in helping countries monitor risk, assess vulnerabilities, and support early warning and resilience efforts. EO data enables progress tracking, risk assessment, and informs actionable strategy across policy areas, from disaster preparedness to climate adaptation.

Fig. 1: Evolution of EO R&I DH Budget (€M) and Key Policy Shifts



Supporting initiatives such as **EU4Health** and the European Centre for Disease Prevention and Control's **(ECDC) Strategy** (2021–2027) further highlight the integration of EO with health system strengthening, emergency preparedness, and surveillance. The **One Health Joint Plan of Action** (2022–2026) promotes cross-sector collaboration, recognising EO as vital for monitoring and responding to environmental and health threats. The EU **Global Health Strategy** (2022) and WHO's **Global Digital Health Strategy** similarly endorse using digital and geospatial data – including satellite EO – to advance global health outcomes and coordinated risk management.

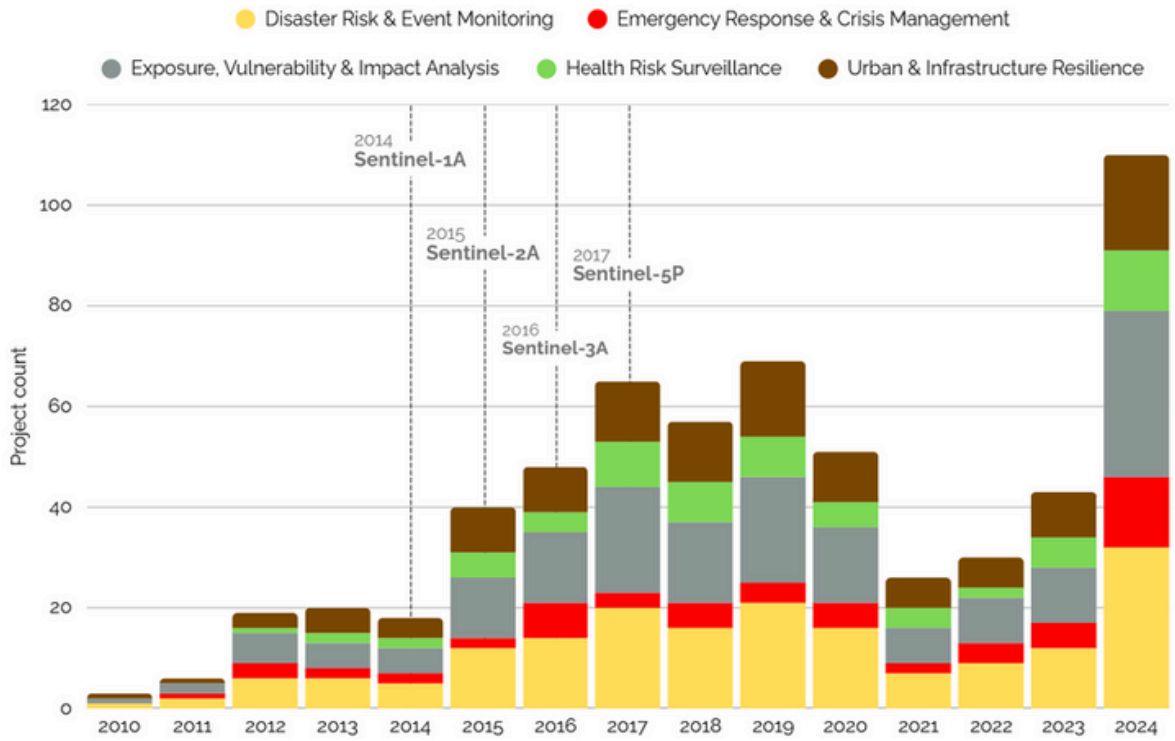
Figure 1 depicts fluctuations in European budgets for EO-related R&I efforts in disaster resilience and health, generated with the sampled data of 188 European-funded projects extracted from RIO. The data has been mapped against relevant policy implementations to analyse potential correlations. The graph clearly demonstrates that **major increases in budget allocation closely follow the timing and ambition of high-level EU policy launches and global frameworks**. Durable growth aligns with foundational directives and global goals, while pronounced jumps coincide with the most recent, integrated EU policies emphasising resilience, early warning, and adaptation. This strongly supports that EU disaster and health R&I funding evolution is policy-driven, with the largest inflections occurring as a direct result of strategic policy interventions – especially in the years following 2019 and peaking sharply after 2022.

In the period from 2011 to 2017, steady growth is observed, reflecting earlier policy groundwork such as the **EU flood directive** (2007) and **Urban Agenda for the EU** (2016–2027), and the continued implementation of UN frameworks of SDGs and Sendai (2015). A peak increase aligns with the EU Green Deal from 2019, further strengthened by **EU strategy for biodiversity** (2020) and **climate adaptation** (2021), as well as the revision period of the **EU Civil Protection Mechanism** (2019). These all emphasise integrated, climate-related, and health-aware resilience efforts.

Figure 1 demonstrates a surge more recently in 2023-2024, which coincides with ambitious launches like the **EU Disaster Resilience Goals** in 2023, the EU Civil Protection Mechanism in 2019, coupled with global momentum from the UN's **Early Warning for All** (2022). These policies directly target gaps in Europe's disaster early warning and preparedness, increasing funding sharply for relevant R&I. It is important, however, to note that the alignment of budget increases with key policy events may reflect a shift in priorities or funding in response to these frameworks, but this chart alone does not establish a direct causal relationship.

Technological Perspectives

Fig. 2: DH Project Count Timelines by Application & Sentinel Missions



EO technologies have become increasingly central to disaster resilience and health applications in Europe, driving advances in hazard detection, risk mapping, and impact assessment. The Sentinel missions – especially **Sentinel-1 (radar) and Sentinel-2 (multispectral)** – form the backbone of Europe's public EO infrastructure, offering continuous, high-resolution data streams that support a wide range of disaster and health monitoring activities. Sentinel-3 and Sentinel-5P further contribute by providing ocean, land, and atmospheric data that's essential for integrated risk and environmental surveillance. These platforms, combined with in-situ sensors and modelling, deliver critical inputs for environmental intelligence within key Copernicus services and EU agencies, including **CEMS (Copernicus Emergency Management Service)**, CAMS (Atmosphere), EEA (European Environment Agency), CLMS (Land), and **C3S (Climate)**. The recent deployment of **Sentinel-1C and Sentinel-2C** in 2024 further strengthens data continuity and resolution for new research and operational needs.

The combination of EO with AI, data cubes, in situ sensors, and GNSS is increasingly used to improve disaster and health management. **AI and data cubes enable rapid, automated analysis of large EO datasets – supporting detection of events like wildfires, disease risks, and pollution patterns**. Integrating in situ and GNSS data enhances geolocation accuracy, enables real-time mapping, and improves risk models for hazards such as floods, landslides, and epidemics. This synergy makes monitoring more effective and supports faster, evidence-based responses in crisis situations. An ongoing example is the **ForestFireAI** project which uses AI to combine satellite images with weather, land cover, and historical fire data to predict and map forest fire risk across Europe. This helps authorities target prevention and early warning more effectively. Furthermore, the **SEED-FD** project advances disaster preparedness by using satellite EO data and local micro-sensors to improve global flood and drought forecasts. This is done by enhancing the CEMS models with real-time data, improved hydrological processes, and AI. SEED-FD delivers more accurate and timely early warning tools which help authorities and communities better predict, prepare for, and manage extreme events.

Technological Perspectives

Despite these advancements, key challenges remain which include **difficulties integrating** diverse data sources due to heterogeneity and lack of harmonisation, limited real-time data access and infrastructure gaps, bureaucratic and funding barriers, and a need for more user engagement and effective adoption within public institutions. Additional issues involve **fragmented standards, insufficient ground-truth data** sharing, and limited resources for outreach and sustainability. These obstacles affect the impact and uptake of EO-powered disaster and health solutions across Europe.

Project counts for disaster and health applications from the RIO database show clear surges following the launch of major Copernicus Sentinel satellites – **especially Sentinel-1 (radar), Sentinel-2 (multispectral), and Sentinel-5P (air quality)**. Figure 2 indicates that project peaks are frequently aligned with new Sentinel deployment phases: with a major growth phase in 2014–2018 (driven by Sentinel-1A, 2A/B, and 3A), followed by sustained high activity from 2017–2019 as Sentinel-3A/B and Sentinel-5P expanded EO capabilities for diverse research areas like exposure, vulnerability, and urban resilience. A plateau in 2020–2021 is apparent, likely due to external factors such as the COVID-19 pandemic rather than direct limits in EO data availability, while 2023–2024 shows another dramatic uptick possibly triggered by new policy measures and anticipated launches of Sentinel-1C and 2C. On another note, fluctuations and sudden changes in project counts may also reflect natural cycles in project timelines and funding mechanisms, which can influence when new research is initiated or reported.

These data demonstrate that the introduction and expansion of Sentinel missions temporally correlate with notable increases in project launches, particularly for applications reliant on advanced EO data streams. **“Exposure, Vulnerability & Impact Analysis”** and **“Urban & Infrastructure Resilience”** consistently see the strongest gains, amplified by both policy momentum and expanded technical capabilities. While the evidence does not establish direct causality, the alignment of surges in R&I projects with technological and policy advances supports the view that new satellite infrastructure and innovation drive rapid growth and diversification in disaster and health-related applications.

Market Trends

Global **demand for disaster preparedness systems** is rising rapidly, with the market estimated at **US$163.6 bn** in 2022 and projected to reach US$308 bn by 2030, reflecting an annual **growth rate of 8.5%**.🔗 A related analysis of the incident and emergency management market similarly forecasts growth from US$137.45 bn in 2024 to US$196.2 bn by 2030 at a Compound annual growth rate **(CAGR) of 6.1%**.🔗 These figures are based on industry research and capture the expanding investment and innovation landscape in disaster readiness worldwide. They encompass a broad range of technologies and service areas beyond the EO research and innovation focus of this report. Within these figures, health-related activities – including epidemic preparedness, public health surveillance, and environmental health risk assessment – represent an important, though not separately quantified, share of the market and are central to the DH-AG's scope.

According to the EUSPA EO and GNSS Market Report 2024, sales of EO services and data for the emergency and humanitarian aid segment amount to around **EUR 223 m**. Of this, preparedness (35%), prevention and mitigation (20%), and response (16%) together make up about 71%, roughly €158m.🔗 "Preparedness" is defined as the use of EO and GNSS to monitor hazards and provide early warnings, enabling timely action before disasters (e.g., droughts, landslides, floods, wildfires, storms). "Prevention and Mitigation" consists of applying EO to identify risks and inform measures that reduce potential disaster impacts (e.g., hazard mapping, exposure analysis for floods, wildfires, earthquakes). Last, "Response" leverages EO and GNSS for rapid damage assessment, situational awareness, and coordination during and after an emergency (e.g., mapping flood extent, wildfire monitoring, crisis area assessment). These three areas represent the **core commercial EO market** the most aligned with DH-AG priorities, showing strong commercial interest in these disaster risk management phases. Within EUSPA's framework of EO applications, those related to air quality monitoring and other health-specific applications fall into different segments that extend beyond DH-AG's scope, making their relevant market share difficult to isolate and quantify.

Fig. 3: Budget Distribution for EO-Related R&I in DH

Figure 3 shows how total budgets are distributed across application areas. The largest proportion of funding goes to **Disaster Risk & Event Monitoring and Exposure**, Vulnerability & Impact Analysis, similar to project counts distribution. This likely reflects both the complexity and scale of projects tackling foundational hazard and vulnerability issues. Urban & Infrastructure Resilience receives a notable share, supporting multi-year and multidisciplinary efforts in urban risk reduction. Emergency Response & Crisis Management and Health Risk Surveillance receive smaller parts of the budget, which may reflect either smaller-average project sizes or their integration as components within broader projects.

Together, these figures show that **research activity and investment concentrate on foundational applications** – risk assessment, hazard monitoring, and mitigation – while urban resilience, emergency response, and health surveillance represent smaller but important segments. This emphasis on proactive and preventive approaches in public R&I closely mirrors commercial market trends, where preparedness and mitigation dominate the EO applications landscape, as also highlighted by EUSPA. The parallel distribution in both sectors underscores a broad consensus on the value of anticipatory risk management in disaster and health fields.

Looking at the evolution over the last 10 years, budgets have been growing steadily, corresponding to the budget allocation across applications. The relative budget shares among thematic areas remain remarkably stable across the period studied, despite absolute budget growth and major policy or data infrastructure changes. This suggests a resilient, **portfolio-oriented funding strategy**, with no dominant pivot toward or away from any individual application theme.

Projections

Future EO research R&I will not only focus on advancing intelligent systems and new technologies but also on addressing a broader range of hazards – including slow-onset threats such as **sea-level rise** and **chronic health risks** linked to climate change. Emerging European Commission strategic roadmaps emphasise interdisciplinary collaboration, societal resilience, and global equity in tackling climate-health risks.

Digital twin technologies, such as those developed under the **Destination Earth initiative**, will enable interactive scenario modelling, giving authorities tools to predict and plan for extreme weather, urban heat, and cascading disasters. **Automation**, using trustworthy AI and multi-hazard analytics, will become standard for real-time risk mapping, early warnings, and resource management across agencies and borders.,

Research is expanding to include the **citizen dimension**, user-focused downstream services, and **integrated approaches** that combine EO, GNSS, and in situ data for full disaster risk management cycles – from prevention and preparedness to emergency response and recovery. Progress depends on open innovation, scaling up successful pilots, and further synergies between Horizon Europe, Copernicus, and national R&I initiatives.

In health, the expansion of EO-based analytics is set to improve fine-scale mapping of environmental hazards and their effects on public health – including better surveillance of air pollution, heat stress, and infectious disease risks. The EuroGEO health expert study emphasises how EO-powered health intelligence will support evidence-based decision-making and scalable monitoring solutions for policymakers, local authorities, and international organisations.

Both expert studies (Disaster Resilience and Health) foresee growing capacity-building efforts and collaborative design processes, involving stakeholders across government, academia, and private sector. These approaches will help ensure broad uptake, commercialisation, and long-term sustainability for EO-driven innovations. ,

EuroGEO Contribution

The EuroGEO DH-AG plays an important part in advancing key EU and UN initiatives by raising awareness, showcasing diverse achievements in research and technological development, as well as coordinating and contributing with recommendations about relevant policies and their implementation. Their efforts include sophisticated data gathering, processing, and dissemination using data cubes and high-performance computing, alongside the deployment of operational services and early warning platforms that combine satellite, in-situ, crowdsourced and modelled data through advanced algorithms and AI. These activities are strongly backed by European funding and **leverage Copernicus infrastructure**, underlining their significance as notable advances within both EuroGEO and Copernicus efforts.

EuroGEO is actively coordinating the selection and scaling up of high-impact EO services, ensuring **synergy between its Action Groups**, Copernicus core services, and **GEO** flagship initiatives. Through improved FAIR data standards, EuroGEO aims to make data findable, accessible, interoperable, and reusable for all stakeholders. This is supported by new tools and infrastructures for cross-sectoral and transboundary crisis management.

Contributions include the expansion of **eoMALL** and dedicated monitoring platforms, allowing municipalities and researchers across Europe to access state-of-the-art EO products, scenario planning tools, and disaster intelligence dashboards. EuroGEO is also strengthening **capacity-building**, user co-design, and knowledge transfer to maximise the real-world impact and sustainability of its solutions.

Strategically, EuroGEO's roadmap aligns with the latest **EU Strategic Research and Innovation Agenda on Health and Climate Change** , as well as ongoing Sentinel launches, to foster adaptation, mitigate health inequalities, and reinforce policy implementation at every level. By 2030, EO-enabled digital twin services, automated early warning platforms, and multi-risk assessment tools are expected to be foundational for integrated disaster and health resilience, contingent on strong policy support and open data ecosystems.

Glossary

AG	Action Group
AI	Artificial Intelligence
C3S	Copernicus Climate Change Service
CAGR	Compound Annual Growth Rate
CAMS	Copernicus Atmosphere Monitoring Service
CEMS	Copernicus Emergency Management Service
CLMS	Copernicus Land Monitoring Service
COSME	Programme for the Competitiveness of Enterprises and SMEs
DH	Disaster Resilience and Health
ECDC	European Centre for Disease Prevention and Control
EDIDP	European Defence Industrial Development Programme
EEA	European Environment Agency
EO	Earth Observation
ESA	European Space Agency
EuroGEO	Europe's regional initiative within the Group on Earth Observations (GEO)
EuroGEOSec	EuroGEO Secretariat project
FAIR	Findable, Accessible, Interoperable, Reusable (data principles)
GNSS	Global Navigation Satellite System
HPC	High-Performance Computing
IPCC	Intergovernmental Panel on Climate Change
KCEO	Knowledge Centre on Earth Observation
LIFE	(EU) Programme for Environment and Climate Action
ML	Machine Learning
R&I	Research and Innovation
RIO	Research and Innovation Observatory
SAR	Synthetic Aperture Radar
SDGs	Sustainable Development Goals
SMEs	Small and Medium-Sized Enterprises
UN	United Nations
WHO	World Health Organization
WP3	Work Package 3

This report has been developed by **Evenflow** under the **EuroGEOSec** project. Further reviewers include EuroGEOSec's project management team.

Disclaimer: This report is based on research from the prototype Research & Innovation Observatory (RIO), and complemented by expert input where available, it may not fully represent the positions of the Disaster Resilience and Health EuroGEO Action Group.

Funded by the European Union

Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

EuroGEO