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List of Acronyms

Acronym	Description
AMNet	Atmospheric Mercury Network
CNR	Consiglio Nazionale delle Ricerche
COP	Conference of Parties
DIAS	Data and Information Access Services
EARSC	European Association of Remote Sensing Companies
EC	European Commission
ECCC	Environment and Climate Change Canada
ECCSEL ERIC	European Research Infrastructure for CO2 Capture, Utilisation,
	Transport and Storage
EGD	European Green Deal
EIRENE	Environmental Exposure Assessment Research Infrastructure
EMODnet	European Marine Observation and Data Network
EODC	Earth Observation Data Centre (for Water Resources Monitoring)
ESD	European Strategy for Data
ESG	Environmental, social, and governance
EU	European Union
EUCENTRE	European Centre for Training and Research in Earthquake Engineering
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EUREF	Europäisches Energieforum
FAIR	Findable, Accessible, Interoperable, Reusable
GDDS	Green Deal Data Space
GDSS	Geographic Decision Support System
GEO	Group on Earth Observations
GFM	Global Flood Monitoring
GHG	Greenhouse gases
GMOS	Global Mercury Observing System
GNSS	Global Navigation Satellite System
GOS4M	Global Observation System for Mercury
GOS4M-KH	Global Observation System for Mercury Knowledge Hub
HELCOM	Convention on the Protection of the Marine Environment in the Baltic
	Sea Area
HVD	High Value Data sets
ICES	International Council for the Exploration of the Sea
IDC	International Data Corporation
IGF PAS	Instytut Geofizyki Polskiej Akademii Nauk
IIASA	International Institute for Applied Systems Analysis
INGV	Istituto Nazionale di Geofisica e Vulcanologia
INSPIRE	Infrastructure for Spatial Information in Europe
JERICO	Joint European Research Infrastructure of Coastal Observatories



JRC	Joint Research Centre
LSH	Large-Scale Hydrology
MCM	Minamata Convention on Mercury
NWP	Numerical Weather Prediction
OSPAR	Convention for the Protection of the Marine Environment of the North-
	East Atlantic
RDM	Research Data Management
RDM	Research Data Management
SAR	Synthetic Aperture Radar
SSBE	Seascape Belgium
UN	United Nations
UNEP-GMP	UNEP Partnership on Mercury air transport and fate research
UNEP-MAP	Convention for the Protection of Marine Environment and the Coastal
	Region of the Mediterranean
UU	Utrecht University
WP	Work Package
WU	Wageningen University & Research



Executive Summary

The European Green Deal (EGD) is a flagship initiative introduced by the European Commission (EC) to combat climate change and create a resource-efficient economy with zero net greenhouse gas emissions by 2050. Achieving this involves a parallel green and digital transition, known as "twin transitions", as well as investment in technology. To support the EGD's goals, the Green Deal Data Space (GDDS) will be established as a shared infrastructure, enabling access to high-quality, interoperable data and services. The GDDS aims to address data fragmentation and inconsistency issues by promoting data sharing across sectors while respecting data holders' rights and European values.

The goal of the GREAT project is to establish the Green Deal Data Space Foundation and Community of Practice that are the prerequisite for its future implementation, evolving existing data ecosystems into an integrated system with the involvement of an expanding cross-sectoral pan-European network. The framework that GREAT implements consists of five pillars:

- 1. the Community of Practice
- 2. the reference blueprint architecture
- 3. the priority list of data sets
- 4. the data governance scheme
- 5. the implementation roadmap

which are incorporated and driven by requirements from use cases and stakeholders from the Green Deal domain.

The present deliverable reports on the activities related to the definition of an expandable core set of high value datasets for the first implementation phase of the data ecosystem federation and presents the initial version of the priority list of data sets and services. More specifically, Section 1 provides an overview of the European Data Strategy and the European Green Deal policies, between which the Green Deal Data Space stands, and introduces the reader to the GREAT project and the WP5 Priority Data sets.

Section 2 dives more into the EGD, giving insights into its specific objectives and analysing the three EGD strategic actions that GREAT focuses on: the 2030 Biodiversity Strategy, the Zero-pollution Action Plan and the Climate Change Adaptation Strategy. In addition, it provides some background information on major European data initiatives, the High Value Data sets and INSPIRE, but also the international Essential Variables initiative, and explains how these are used in GREAT.

In Section3, the five Reference Use Cases and Initiatives of Phase 1 are described based on information that was collected from the use case representatives, and more specifically, these are: Hydrology Use Cases (Large-Scale Hydrology and Seasonal Forecasting of Water Resources), Global Observation System for Mercury (GOS4M), European Marine Observation and Data Network (EMODNET), European Plate Observing System European Research Infrastructure Consortium (EPOS ERIC) and BioGIS 360. The Reference Use Cases and Initiatives have been



providing requirements and sharing expert knowledge for the creation of the initial GD data inventory.

Section 4 provides a detailed description of the Green Deal data inventory. It explains the approach that was followed for the creation of the two databases: the high priority data set inventory and the data services inventory, their structure and organisation and the prioritisation process of the data services. In addition, the lists of the Phase 1 high priority data sets and services are included, the full versions of which can be found in the Appendices A and B respectively.

Finally, Section 5 closes the document with some conclusions, recommendations and outlook for the activities related to the Priority Data sets during the second phase of the project.



1 Introduction

1.1 The European Data Strategy

Data-driven innovation plays a key role in the digital transformation of our society and organisations¹. The priority "A Europe fit for the digital age"² guides the European Commission's policy agenda for the period of 2019-2024, culminating in the EC's vision for Europe's digital transformation "2030 Digital Compass: the European way for the Digital Decade"³ which sets ambitious targets aimed at strengthening digital sovereignty through specific actions on data, technology and infrastructures. The Annual Single Market Report⁴, published in 2023, marks the 30th anniversary of the Single Market, and highlights the ambition to create a single EU data economy through a data-driven Single Market where interoperability within and across data spaces is ensured.

On February 2020, the European Commission published a Communication introducing "A European strategy for data"⁵ (ESD) for the creation of "a single European data space – a genuine single market for data, open to data from across the world". The strategy to achieve this vision is articulated around four main pillars:

- 1. A cross-sectoral governance framework for data access and use;
- 2. Enablers: Investments in data and strengthening Europe's capabilities and infrastructures for hosting, processing, and using data, interoperability;
- 3. Competences: Empowering individuals, investing in skills and in SMEs;
- 4. Common European data spaces in strategic sectors and domains of public interest.

According to the ESD, Data Spaces should foster an ecosystem (of companies, civil society and individuals) creating new products and services based on more accessible data. In addition, what distinguishes the Common European Data Spaces from other data sharing initiatives is its focus on preserving European values, balancing the flow and wide use of data, while preserving high privacy, security, safety and ethical standards. One of the nine proposed common European data spaces is the Green Deal Data Space, for which the GREAT project is charged with developing an implementation roadmap, including a technical blueprint, governance scheme and priority datasets.

¹ Granell, C., Mooney, P., Jirka, S., Rieke, M., Ostermann, F., Van Den Broecke, J., Sarretta, A., Verhulst, S., Dencik, L., Oost, H., Micheli, M., Minghini, M., Kotsev, A. and Schade, S., Emerging approaches for data-driven innovation in Europe: Sandbox experiments on the governance of data and technology, EUR 30969 EN, Publications Office of the European Union, Luxembourg, 2022, <u>doi:10.2760/511775</u>.

² European Commission, Directorate-General for Communications Networks, and Content and Technology, *Shaping Europe's digital future*, Publications Office, 2020, <u>https://data.europa.eu/doi/10.2759/091014</u>

³ European Commission, Directorate-General for Communications Networks, Content and Technology, 2030 digital compass – The European way for the digital decade, Publications Office, 2021, https://data.europa.eu/doi/10.2759/425691

⁴ European Commission, Commission Staff Working Document 2023 Annual Single Market Report: Single Market at 30, SWD(2023) 26 final, 2023, <u>https://op.europa.eu/s/yXTN</u>

⁵ European Commission, "A European strategy for data." COM(2020) 66 final 2020. <u>https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52020DC0066&from=EN</u>



To support the ESD, in November 2020, the EC proposed a Data Governance Act⁶ aiming at increasing trust in data sharing and facilitating data reuse. In February 2022, the EC proposed a Data Act⁷ to make more data available for use in line with EU rules and values. The Data Governance Act creates the processes and structures to facilitate data, while the Data Act clarifies who can create value from data and under which conditions. Finally, in the framework of the Open Data Directive⁸, the European Commission adopted an Implementing Act⁹ specifying certain "High Value Datasets" that public sector organizations will have to make available free of charge, in machine-readable format.

1.2 The European Green Deal

In parallel with the "digital transition" described above, there is an equally important "green transition." The European Commission demonstrated unprecedented leadership in December 2019 when it unveiled its flagship action plan¹⁰ to tackle climate change, the European Green Deal. Through this strategy, the European Union (EU) aims to become the first resource-efficient and competitive economy without net emissions of greenhouse gases by 2050.

The European Green Deal has been expressed through a vast number of policies and plans, charting a comprehensive course for action, supported by a growing number of legislative and regulatory actions. The Green Deal sets ambitious objectives, including restoring degraded ecosystems at land and sea across Europe with the 2030 Biodiversity Strategy¹¹ and reducing greenhouse gas emissions to zero by 2050 with the European Climate Law¹² and the Zero Pollution Action Plan¹³. In addition to regional action, part of the action plan is to increase the EU's "green diplomacy" and demonstrate EU leadership in multilateral fora to increase collective effort and reach the objectives of the Paris Agreement¹⁴ and the United Nations Sustainable Development Goals (UN SDGs).

⁶ European Commission, REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on European data governance and amending Regulation (EU) 2018/1724 (Data Governance Act) <u>https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52020PC0767</u>

⁷ European Commission, "Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on harmonised rules on fair access to and use of data (Data Act)." COM(2022)68 final <u>https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52022PC0068&from=EN</u>

⁸ Directive (EU) 2019/1024 of the European Parliament and of the Council of 20 June 2019 on open data and the reuse of public sector information (recast) (OJ L 172 26.06.2019, p. 56, ELI: <u>http://data.europa.eu/eli/dir/2019/1024/oj</u>)

⁹ European Commission, "Commission Implementing Regulation (EU) 2023/138 of 21 December 2022 laying down a list of specific high-value datasets and the arrangements for their publication and re-use." 2023. <u>https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32023R0138&from=EN</u>

¹⁰ European Commission, "COMMUNICATION FROM THE COMMISSION The European Green Deal" COM(2019) 640 final <u>https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52019DC0640</u>

¹¹ European Parliament, Directorate-General for Internal Policies of the Union, Nègre, F., The EU 2030 biodiversity strategy, European Parliament, 2020, <u>https://data.europa.eu/doi/10.2861/545892</u>

¹² Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law') (OJ L 243 09.07.2021, p. 1, ELI: http://data.europa.eu/eli/reg/2021/1119/oj)

¹³ European Commission, COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Pathway to a Healthy Planet for All EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil' COM(2021)400 final https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52021DC0400&from=EN ¹⁴ https://unfccc.int/process-and-meetings/the-paris-agreement



Ambitious action plans like the European Green Deal require an abundance of resources, including viable data. Data allows governments to identify risks, tailor policy response and resource allocation, monitor progress and identify trends. While some consequences of climate change are irreversible, data gaps and analytics deficits need to be addressed.

1.3 The Green Deal Data Space

The Green Deal Data Space stands at the intersection of two major European policy initiatives: the EU Strategy for Data and the European Green Deal. The GDDS will be designed and implemented to exploit the potential of data to effectively support the Green Deal priority actions, empowering policy makers, businesses, researchers and citizens, from Europe and around the world, to jointly tackle issues such as climate change, circular economy, zero pollution, biodiversity protection, deforestation and compliance assurance.

Out of the many European Green Deal strategic actions, the GREAT project focusses on three priorities (Biodiversity 2030, Zero Pollution and Climate change), in order to effectively capture the diversity of requirements across the full range of the European Green Deal. These three initiatives are interlinked with other EGD strategic action, covering the full scope of the GDDS, as well as complementing actions being addressed by other thematic data spaces (such as the "Farm to Fork Strategy" being addressed by the agricultural data space¹⁵).

1.4 Work Package 5: Priority Data sets

Work Package 5 focuses on identifying an expandable core of high priority data sets and services that are required by key use cases, addressing crucial topics in the European Green Deal domain, (see Section 3 for their detailed description) to achieve their objectives. This set of data sets is foreseen to be used for the first implementation phase of the data ecosystem federation.

To accomplish this objective, WP5 has been creating an inventory of available data sets and services related to the European Green Deal, and more specifically to the three strategic actions that the GREAT project focuses on: the 2030 Biodiversity Strategy, the Zero-pollution Action Plan and the Climate Change Adaptation Strategy (see Section 2.2). This inventory is created based on specific data requirements collected by, first of all, the interaction and analysis of the Reference Use cases and Initiatives (see Section 3) in two phases and by the project's engagement with major actors from both private and public sectors involved in the initiative. In this first phase of the project, the WP has been interviewing and collecting requirements from the five Reference Use Cases and Initiatives: Hydrology Use Cases (Large-Scale Hydrology and Seasonal Forecasting of Water Resources), Global Observation System for Mercury (GOS4M), European Marine Observation and Data Network (EMODNET), European Plate Observing System European Research Infrastructure Consortium (EPOS ERIC) and BioGIS 360, and has interacted with numerous external entities though the established Task Forces¹⁶ and but also through engagement activities with initiatives relevant to the Green Deal. For their integration in the Green Deal Data

¹⁵ <u>https://digital-strategy.ec.europa.eu/en/library/common-european-data-spaces-agriculture-and-mobility</u>

¹⁶ The GREAT Task Forces and their function in the project are described in the WP2 deliverable D2.1: Dissemination, Strategy, Plan & Materials.



Space, the data sets and services are prioritised based on several criteria, namely their utility for Reference Use Cases, their relevance to European Green Deal objectives, and certain data properties. Additionally, the WP aims to identify data types that are desired but not yet available or are hard - for different reasons – to access and/or use in order to fully implement Reference Use Cases and specific European Green Deal objectives.

The Work Package is led by the Earth Observation Data Centre (EODC), while Wageningen University & Research (WU), Utrecht University (UU), International Data Corporation (IDC) and the European Association of Remote Sensing Companies (EARSC) contribute to its activities.



2 **GREAT Data Themes**

2.1 EGD Objectives

The European Green Deal is a roadmap and policy framework introduced by the European Commission in December 2019. In the following, the EGD key objectives are described in more detail.

2.1.1 Objective 1: Climate Neutrality

The primary objective of the European Green Deal is to achieve climate neutrality by 2050. This means balancing greenhouse gas (GHG) emissions with removals, effectively reaching a state where Europe's net emissions are reduced to zero. To accomplish this, the EU aims to implement a series of measures, including:

Sub-Objective 1.1: Enhancing Energy Efficiency: The Green Deal prioritizes improving energy efficiency across various sectors, such as buildings, transportation, and industry. By promoting energy-efficient technologies, retrofitting existing infrastructure, and adopting stringent efficiency standards, the EU aims to reduce energy consumption and associated emissions.

Sub-Objective 1.2: Expanding Renewable Energy: A significant focus of the Green Deal lies in accelerating the deployment of renewable energy sources. The EU plans to increase the share of renewable energy in the overall energy mix and support the development of clean technologies, such as wind, solar, and hydropower.

Sub-Objective 1.3: Revamping the Energy System: The European Green Deal seeks to transform Europe's energy system, promoting the integration of renewable energy, grid modernization, and energy storage solutions. By developing a smarter, more flexible energy infrastructure, the EU aims to ensure a reliable and sustainable energy supply while reducing dependence on fossil fuels.

2.1.2 Objective 2: Sustainable Industry and Circular Economy

The European Green Deal recognizes the need to reshape Europe's industrial landscape to align with sustainability goals. Key objectives under this pillar include:

Sub-Objective 2.1. Promoting Sustainable Production: The Green Deal aims to encourage sustainable practices and technologies across industries, fostering the transition towards a circular economy (see sub-objective 2.2). This involves reducing waste, promoting resource efficiency, and minimizing the environmental impact of manufacturing processes.

Sub-Objective 2.2. Circular Economy Action Plan: The EU has introduced a comprehensive Circular Economy Action Plan that emphasizes resource efficiency, waste prevention, and the recycling and reusing of materials. By promoting the principles of a circular economy, the Green Deal seeks to minimize waste generation and maximize resource utilization.

Sub-Objective 2.3. Sustainable Mobility and Transport: The European Green Deal aims to revolutionize the transport sector by promoting sustainable mobility options. This includes



supporting the development of electric vehicles, investing in clean public transportation systems, and improving infrastructure to encourage walking and cycling.

2.1.3 Objective 3: Biodiversity Conservation and Sustainable Agriculture

Preserving and restoring biodiversity is crucial for a sustainable future. The Green Deal outlines several objectives to safeguard ecosystems and promote sustainable agricultural practices:

Sub-Objective 3.1. Protecting Nature and Ecosystems: The EU aims to increase the protection and restoration of biodiversity-rich areas, such as forests, wetlands, and marine habitats. This involves establishing a network of protected areas, enhancing conservation efforts, and implementing measures to combat wildlife trafficking and habitat destruction.

Sub-Objective 3.2. Sustainable Farming Practices: The Green Deal emphasizes the adoption of sustainable agricultural practices that minimize the use of pesticides, promote organic farming, and encourage agroecology. The EU plans to support farmers in transitioning towards more sustainable production methods while ensuring their economic viability.

2.1.4 Objective 4: Sustainable Finance and Just Transition

To facilitate the transition to a sustainable economy, the European Green Deal places significant emphasis on mobilizing financial resources and ensuring a just and inclusive transition:

Sub-Objective 4.1. Sustainable Finance Strategy: The EU aims to redirect capital flows towards sustainable investments by developing a comprehensive sustainable finance strategy. This involves integrating environmental, social, and governance (ESG) factors into financial decision-making and leveraging public and private investments to support green initiatives.

Sub-Objective4.2. Social Dimension and Just Transition: The Green Deal recognizes the importance of ensuring a fair and inclusive transition for all stakeholders. It emphasizes the need to address social and economic disparities that may arise during the transition, ensuring that vulnerable groups are not left behind.

The Green Deal aims to combat climate change, foster sustainable growth, and protect the environment and biodiversity. As Europe works towards a climate-neutral future, the implementation of the Green Deal will require close collaboration, innovative solutions, and a commitment to balancing economic progress with environmental stewardship. The objectives are accompanied by various legislative proposals, funding mechanisms, and partnerships at the European level to facilitate their implementation and support of member states in achieving the goals of the European Green Deal.

2.2 EGD Actions in GREAT

The European Green Deal comprises a range of distinct actions, each strategically designed to address pressing environmental challenges while fostering economic growth and social well-being. The GREAT project (mainly) focuses on three of them:

- the 2030 Biodiversity Strategy,
- the Zero-pollution Action Plan and



• the Climate Change Adaptation Strategy,

as discussed in Section 1. In the following sections (2.2.1, 2.2.2 and 2.2.3), information on the goals of each of them is provided.

2.2.1 2030 Biodiversity strategy

The EU Biodiversity Strategy for 2030¹⁷ is a core part of the European Green Deal that focuses on actions to protect biodiversity and restore degraded ecosystems by 2030. The strategy focuses on (1) expanding the network of protected areas and (2) the restoration of nature.

In terms of protected areas, the strategy includes a commitment to protect 30% of the land and marine area of the European Union, of which at least a third of the areas that are most important to biodiversity are to be strictly protected, by 2030. The strategy also includes a target for effective management and monitoring of protected areas. Special focus is given to the protection of primary and old-growth forests.

The EU Biodiversity Strategy for 2030 includes an ambitious nature restoration plan that aims to prevent and reverse the deterioration of species by restoring degraded ecosystems, with a particular focus on ones with a high potential for carbon sequestration. The plan targets the agriculture sector with aims to reduce the use of pesticides and pollution from fertilisers, as well as promotes high-diversity landscape features and organic farming. In addition, the plan includes a pledge to plant three billion trees by 2030, and to restore marine, freshwater and soil ecosystems. Lastly, the plan aims to address invasive species and promote urban greening.

The strategy complements these targets with an aim to enable transformative change for biodiversity conservation and restoration by introducing a new governance framework and means of measuring the value of nature, as well as stepping up the implementation and enforcement of EU environmental legislation. The strategy raises the level of ambition and commitment to tackling deforestation, wildlife trafficking, and illicit trade worldwide and encourages international cooperation for biodiversity protection and restoration.

2.2.2 Zero-pollution Action Plan

The Zero-pollution Action Plan¹⁸ focuses on three key areas: (1) air pollution, (2) water pollution, and (3) soil pollution. It recognizes the interconnectedness of these issues and the need for integrated solutions. In general, the Zero-pollution Action Plan recognizes the need for strong governance, policy coherence, and stakeholder engagement to achieve its objectives. It emphasizes the role of research and innovation in developing sustainable solutions and encourages collaboration between member states, industry, and civil society.

Regarding air pollution, the plan aims to reduce harmful emissions from industrial activities, transport, and households. It promotes the use of cleaner energy sources, such as renewable

¹⁷ https://environment.ec.europa.eu/strategy/biodiversity-strategy-2030_en

¹⁸ https://environment.ec.europa.eu/strategy/zero-pollution-action-plan_en



energy, and encourages the adoption of sustainable mobility options. The plan also addresses indoor air quality and sets targets to improve it.

In terms of water pollution, the action plan seeks to enhance the quality and availability of freshwater resources. It emphasizes the importance of protecting rivers, lakes, and coastal waters from pollution sources, such as industrial discharges and agriculture runoff. The plan promotes sustainable water management practices and the use of innovative technologies for water treatment.

To combat soil pollution, the action plan focuses on preventing the contamination of soil with hazardous substances. It encourages the remediation of contaminated sites and promotes sustainable land use practices.

The plan also aims to address the issue of microplastics and promote the circular economy to minimize waste generation. Furthermore, chemical pollution is another critical aspect within all three areas. It aims to ensure the safe use of chemicals and reduce their negative impact on human health and the environment. The plan promotes the substitution of hazardous substances with safer alternatives and advocates for the implementation of a non-toxic environment strategy.

2.2.3 Climate Change Adaptation Strategy

Central to the European Commission's Green Deal is the Climate Change Adaptation Strategy¹⁹. The strategy's overarching goal is to build a climate-resilient society, economy, and ecosystem by improving preparedness and adaptive capacity. It aims to proactively adapt to climate change across various sectors, fostering sustainable development and safeguarding the well-being of European citizens. It promotes the collaboration among member states, regions, and various stakeholders and considers the following sub-domains:

- 1. Risk Assessment and Management: A crucial aspect of the strategy is conducting robust risk assessments to understand the vulnerabilities and potential impacts of climate change. This subdomain involves identifying hazards, evaluating exposure, and assessing vulnerability across sectors and regions. By comprehensively understanding these risks, decision-makers can develop targeted adaptation measures and prioritize resources effectively.
- 2. Infrastructure and Spatial Planning: Recognizing the importance of resilient infrastructure, the Climate Change Adaptation Strategy focuses on enhancing the durability and adaptability of key systems. This subdomain entails incorporating climate resilience into infrastructure design and spatial planning processes. It emphasizes the need to update building codes, improve urban planning, and integrate nature-based solutions to mitigate climate risks.
- 3. Ecosystem-Based Approaches: Preserving and restoring ecosystems plays a pivotal role in climate change adaptation. The strategy promotes the protection of biodiversity, sustainable land management, and the creation of green infrastructure. By leveraging nature-based solutions, such as wetland restoration and afforestation, Europe can enhance its adaptive

¹⁹ <u>https://climate.ec.europa.eu/eu-action/adaptation-climate-change/eu-adaptation-strategy_en</u>



capacity and provide multiple co-benefits, including carbon sequestration and improved water management.

- 4. Health and Social Systems: Addressing climate change impacts on human health and well-being is another crucial subdomain of the Climate Change Adaptation Strategy. It involves strengthening healthcare systems, developing early warning systems for extreme events, and improving public health preparedness. Additionally, social vulnerability assessments are conducted to identify and support marginalized communities at higher risk of climate-related impacts.
- 5. Financial Mechanisms and Governance: To ensure the successful implementation of climate change adaptation measures, the strategy emphasizes the importance of adequate financial resources and effective governance structures. This subdomain focuses on mobilizing funds, promoting public-private partnerships, and aligning financial instruments with climate objectives. Moreover, it emphasizes the integration of adaptation into relevant policies, strategies, and regional development plans.

2.3 EC Data Initiatives

2.3.1 High-Value Data Sets

The Open Data Directive²⁰ in conjunction with the Implementing Regulation²¹ by European Commission introduces the concept of 'high-value data sets' (HVD), denoting data sets with the potential to yield substantial socio-economic or environmental benefits, fostering innovation and services. These data sets, particularly advantageous for SMEs and a wide range of users, are envisioned to generate revenue and harmoniously integrate with other data sets. In adherence to the Directive, these data sets must be accessible without charge. This accessibility is to be facilitated through Application Programming Interfaces (APIs) and bulk download options, where relevant, with an essential requirement of machine-readable formatting. While the directive currently refrains from providing an explicit list of high-value data sets, the Commission Implementing Regulation (EU) 2023/13 Annex²² delineates their thematic categories and some examples of representative data sets for each of them. An overview of these is presented in Table 1 below and schematically visualised in the published "High-value datasets – an overview through visualisation"²³ Data Story.

Table 1: Example data sets for each of the High Value Data sets thematic categories

HVD Thematic category	Examples of data sets in scope
Geospatial	Data sets within the scope of the INSPIRE data themes:
	Administrative units
	Geographical names
	Addresses
	Buildings

²⁰ <u>https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32019L1024</u>

²¹ https://eur-lex.europa.eu/eli/reg_impl/2023/138/oj

²² <u>https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32023R0138#d1e32-48-1</u>

²³ https://data.europa.eu/en/publications/datastories/high-value-datasets-overview-through-visualisation

	Cadastral parcels		
	as defined in Annex I and Annex III to Directive 2007/2/EC ²⁴ .		
	Reference parcels		
	Agricultural parcels		
Earth Observation and	• Earth Observation data sets, including space-based or remotely-		
Environment	sensed data, ground-based or in situ data.		
	Environmental and climate datasets within the scope of the		
	INSPIRE data themes as defined in Annexes to Directive		
	2007/2/EC.		
	• Datasets produced or generated in the context of the legal acts		
	outlined in Section 2.1 of the Commission Implementing		
	Regulation (EU) 2023/138 Annex.		
Meteorological	Observations data measured by weather stations		
	Climate data: validated observations		
	Weather alerts		
	Radar data		
	Numeric Weather Prediction (NWP) model data		
Statistics	Statistical datasets, except microdata, related to reporting		
	obligations as defined in the legal acts outlined in Section 4.1 of the		
	Commission Implementing Regulation (EU) 2023/138 Annex.		
Companies and Company	Basic company information		
Ownership	Company documents and accounts		
	at individual company level and with the key attributes outlined in		
	the Section 5.1 of the Commission Implementing Regulation (EU)		
	2023/138 Annex.		
Mobility	• Data sets within the scope of the INSPIRE data theme 'Transport		
	networks' as set out in Annex I to Directive 2007/2/EC.		
	Inland waterways datasets		

This proactive approach sets the stage for a future, detailed enumeration of these specific data sets, further enriching the potential of the Open Data Directive, as demonstrated by the existing Data Stories²⁵ published in the EC website.

In the European Green Deal, priority data sets are in multiple cases congruent with the high-value data set thematic categories defined by the European Commission. The WP5 team has identified, specifically supported by the five Reference Use Cases and Initiatives of Phase 1 (see Section 3 for more information on these), the Earth Observation and Environment and the Meteorological HVD categories as the highest priority for the initial GDDS. Moreover, these data sets are expected to

²⁴ https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32007L0002&qid=1692710678577#d1e32-12-1

²⁵ <u>https://data.europa.eu/en/publications/datastories</u>



be beneficial for regional, national, international political and executive decisionmakers because of their capability to show global scale impact of climate change processes, and active environmental impacts on human society. On the other hand, for researchers the environmental observations of these categories at any scale are the base for any environmental scientific conclusion, information and innovation that is being published and produces further input for the scientific prognosis for the decision-making process. In conjunction with the identified highest priority categories of the HVDs, the Geospatial, Mobility and Statistical categories are of high priority for the initial GDDS. Specifically, data from the Geospatial category has been added by the Phase 1 Use Cases to the inventory. Additionally, Statistical and Mobility data is sustainably impacting the Green Deal and its success by delivering key indicators about sustainable behaviour on a regional and local level. Therefore, most of these datasets are of regional and local interest, which create innovation and knowledge based on the intersection of these data sets with the highest priority data sets in a changing Climate Adaptation Scenarios. Specifically, regional and local decisionmakers rely on the information from these categories. In addition, as confirmed from the initial use cases, high impact output is generated when these data sets are combined with data from the Earth Observation & Environment and Meteorological categories.

Considered of the lowest priority for the GDDS objectives and data sets is an intersection with the Companies & Company ownership category. These high value data sets of company registries are for the initial GDDS of relevance for specific cases and scenarios. Therefore, data sets of these categories should be considered but are not as high of a priority compared to the other HVD categories. Companies & Company ownership data sets may influence decisions on a local scale but may have global influence on decisionmakers and executive company owners. Therefore, the data space should reflect this data, however, most value is created when it is intersected with the beforementioned categories.

The beforementioned prioritisation of categories reflects the initial GDDS inventory and input from use cases and their perspective on the Green Deal. Hence, the prioritization may change due to currently unrepresented perspectives and unengaged industries. This should be considered while implementing the GDDS and additional industries should be interviewed for their usage of HVD data within Green Deal perspectives.

2.3.2 INSPIRE

INSPIRE (Infrastructure for Spatial Information in the European Community) is a European initiative established to enhance the accessibility, sharing, and use of geospatial information across European Union member states. It aims to create a common framework for geospatial data that enables better decision-making, environmental protection, and sustainable development. INSPIRE facilitates the harmonization of diverse spatial data sets, such as maps, satellite images, and geographic information, ensuring they can be easily accessed, combined, and shared among various organizations and sectors. By promoting interoperability and standardization, INSPIRE contributes to improved collaboration, more informed policymaking, and increased efficiency in addressing complex spatial challenges across the EU.



INSPIRE can provide essential support to the Green Deal Data Space, facilitating the aggregation, integration, visualization and analysis, of different geospatial data sets by setting the standards and specifications geodata needs to comply with within the GDDS. Users of the GDDS should be enabled to easily access, use and analyse cross-border, European geodata, which INSPIRE facilitates by setting defined standards and specifications.

Specifically, Data Aggregation and Integration between EU member states and GDDS participants can be fostered using the INSPIRE directive. INSPIRE can support the integration of diverse environmental data sources by common standards. By ensuring data harmonization and standardization, data integration can be facilitated also between member states. Referring to the HVD categories of Section 2.3.1, INSPIRE can specifically help to integrate Geospatial and Statistical data into the initial GDDS.

Nevertheless, INSPIRE could be additionally extended by minimum user requirements for data access policies and hosting. This may be a key part of GDDS complementing INSPIRE within the GDDS.

Additionally, Collaboration and Knowledge Sharing can be extended using participating INSPIRE partners. This means that INSPIRE can facilitate collaboration and knowledge sharing among stakeholders involved in the Green Deal Dataspace. It enables secure and controlled access to data, allowing researchers, policymakers, businesses, and citizens to exchange insights, best practices, and innovative ideas. Specifically, meteorological and earth observation and environment gridded data are currently missing such high-level common standards in terms of metadata and therefore this knowledge sharing and collaboration from INSPIRE can be helpful and inspiring when setting up common interfaces to large data sets from these domains.

Therefore, by leveraging the capabilities of the INSPIRE directive, the European Green Deal can establish a robust and comprehensive dataspace, facilitating data-driven decision-making and fostering effective and sustainable environmental policies and actions across the European Union.

2.4 Other international data initiative used in GREAT

2.4.1 Essential Variables

Essential Variables (EVs) play a crucial role in the observation and monitoring of various aspects of the Earth system. Diverse international organizations, such as the World Meteorological Organization, the United Nations Environment Program, the International Science Council, and the Group on Earth Observations (GEO), have facilitated collaborative efforts among global institutions to identify these essential variables within their respective domains. This collective endeavour encompasses fields like oceanography, climatology, biodiversity studies, and geodiversity research. The establishment of a standardized, accurate, and continuous measurement framework, accompanied by data collection and dissemination standards, ensures the compatibility and utility of data across different platforms and organizations.

The continuity of precise measurements of these EVs, as endorsed by experts in the respective fields, is paramount for effectively monitoring and assessing changes within Earth's intricate



systems—ranging from the atmosphere and biosphere to land and oceans. Panels of subject matter experts, comprised of individuals from academia, international space agencies such as NASA and the European Space Agency, governmental bodies, and non-governmental organizations, meticulously evaluate the observation requirements for EVs. This evaluation encompasses factors like temporal frequency and spatial resolution. Subsequently, these requirements are matched with the capabilities of existing instruments, spanning from ground-based moorings to advanced satellite systems. Hence, the five essential variable types, namely Climate, Biodiversity, Agriculture, Ocean, and Geodiversity, encompass a holistic framework for comprehending the intricate interactions within our planet's dynamic systems.

Within the GDDS inventory, essential variables play therefore a crucial role in determining priority datasets and services specifically in connection with the HVD categories. For instance, many of the currently added datasets fall into the Earth Observation and Environment or the Meteorological HVD category. Nevertheless, these important categories are further refined by the essential variables and allows identification of missing fields within any HVD category.



3 GREAT Reference Use Cases and Initiatives

As mentioned in earlier sections, the activities within this work package have been strongly based on the five Reference Use Cases and Initiatives in the first phase of the project. In the following, their description is provided based on information that was collected from the use case representatives during the past months.

3.1 Hydrology Use Cases

3.1.1 Large Scale Hydrology

3.1.1.1 Description

The Large-Scale Hydrology use case, represented by the affiliated entity of the GREAT project Utrecht University, the Netherlands, focuses on studies and assessments that use large-scale hydrological data to study past and future trends in fresh-water resources and inform long-term policy decisions. Large-scale hydrology provides vital data that enables society to understand the historical trends in water resources around the world, especially in regions where these resources are used unsustainably. The data coming from large-scale hydrological models enable to quantify hotspots of water scarcity and the long-term effects of changes in societal water demand and climate change. Typically, the simulations are only updated once every year, or even less frequent, but do cover a long temporal range from the early 1900 to 2100. Other variables that are provided by these models are freshwater availability, salinity, and water temperature. This information also supports research in other domains, such as energy science (for cooling water and hydropower), agriculture (irrigation water), ecology (water temperature and availability for nature) and epidemiology (water borne diseases).

To be able to perform these studies, LSH relies on information about the soil properties, evaporation, groundwater levels, reservoir levels, amount of snow, river discharge, and water temperature, land cover, elevation, meteorology, and geology. At the same time, there are data that are not accessible for LSH, which is groundwater data from the USA and reservoir operating policies. The data produced by LSH contain various state and flux variables for human water use, hydrology, and groundwater. The data that are used and produced by the use case have a daily temporal resolution and a global spatial extent.

LSH has a major role in contributing to the *Climate Change Adaptation Strategy* of the EGD. The subdomains LSH assesses are the zero-pollution ambition for a toxic-free environment, preserving and restoring ecosystems and biodiversity, and from 'Farm to Fork': a fair, healthy and environmentally friendly food system.

3.1.1.2 Key stakeholders

The stakeholders for the data (extensions) provided by LSH range from waterboards and policy makers related to flood hazards, scientists including hydrologists, ecologists, epidemiologists, to the agriculture and food industry:

- European Commission, EU Joint Research Centre
- National research institutes related to water resources (e.g., Deltares, NL)



- Universities developing LSH and using data from LSH
- Intergovernmental organizations related to the environment (e.g., World Bank, World Meteorological Organisation, World Wide Fund for Nature, Greenpeace)
- International research organizations (e.g., World Resources Institute, International Institute for Applied Systems Analysis, EODC)
- Local and national governments
- National Geographic

3.1.2 Seasonal Forecasting of Water Resources

3.1.2.1 Description

In the seasonal forecasting of water resources use-case the focus is on the operational water management: short to medium-term decision making that influences the impact that floods and drought have on society. Hydrological ensemble predictions are an essential part of this decision-making process. The hydrological data provides ensemble forecast data that provides information on the potential river discharges for the coming days to weeks. Contrary to the large-scale hydrology use-case these seasonal forecast new data is generated every other month when new forecast information becomes available. The river discharge seasonal forecasts are then used by operational water managers around the world to adjust their reservoir operations, take preventive measures to prevent flood or put in place water use restrictions to reduce drought impacts. To be able to perform these studies, we rely on information about soil moisture, reservoir levels, river discharge, for example (all as ensembles of 51 realisations per forecast). All data has a daily temporal resolution and a global spatial extent.

The use case includes EODC's involvement in the Global Flood monitoring (GFM) activity¹¹, which is led by the Joint Research Centre of the EC (JRC). Next to a global use case on the topic of geohazards this addition provides additional insights in the requirements of the Copernicus Emergency Service. The GFM activity provides a near-real-time monitoring of floods worldwide by immediately processing and analysing all incoming Copernicus Sentinel-1 Synthetic Aperture Radar (SAR) satellite data. The resulting free and open data products are then accessible via a dedicated web portal or an API. Furthermore, the ambition of the Global Flood Awareness System (GloFAS)¹² lies in the forecasting of floods across the world. The Global Flood Awareness System (GloFAS¹³) data, including the GFM monitoring results, are freely accessible to all registered users through a dedicated web platform¹⁴. Results of the GloFAS have the potential to be integrated in the LSH activity as additional information layer as well as for validation purposes.

3.1.2.2 Key Stakeholders

The stakeholders include organisations providing seasonal forecasts and organisations using the data generated by these forecasts for policy making and environmental management including early warnings for geohazards:

• Research institutes developing modelling tools for seasonal forecasting and running operational forecast systems using these tools (e.g., EU Joint Research Centre, ECMWF, Utrecht University, EODC)



- SMEs providing operational forecasts to their customers (e.g., waterboards) and using data from operational forecasts (e.g., Hydrologic (NL), Nelen & Schuurmans (NL))
- Local and national governments using forecast data for management and early warnings

3.2 Global Observation System for Mercury (GOS4M)

3.2.1 Description

The Global Observation System for Mercury (GOS4M)²⁶, represented by the GREAT project partner Consiglio Nazionale delle Ricerche (CNR) from Italy, is a Group on Earth Observation (GEO) Flagship aimed to support the Minamata Convention on Mercury Secretariat, the UN Environment Mercury Fate & Transport Partnership and all Nations in the follow-up of the Conferences of Parties (COP) related to the Effectiveness Evaluation and Global Monitoring framework.

GOS4M federates data collected in monitoring networks on mercury (Hg) and mercury pollution and develops services and tools aimed to simulate scenarios on mercury at a global scale in order to provide robust data-based frameworks for decision-makers. The applications GOS4M develops, with daily to monthly data updates, are based on observations, model outputs and web tools to exploit the wealth of data made available through platforms such as Copernicus DIAS and the GEO Knowledge Hub²⁷. In addition, the GOS4M Knowledge Hub²⁸ (GOS4M-KH) is an operational integrated multi-model and multi-domain computational platform designed to enable scientists, decision-makers and citizens to evaluate the potential effectiveness of measures that nations may undertake to reduce the impact of mercury contamination on human health and ecosystems. The GOS4M-KH provides information on mercury fate, from sources to receptors, and in the future estimates of costs associated with policies. This platform includes analyses of complex chemophysical atmospheric model outputs, bio-geochemical models to simulate processes in the ocean and ecological models to estimate mercury uptake by the trophic net. The GOS4M Knowledge Hub can support the effectiveness evaluation of the Minamata Convention on Mercury.

GOS4M contributes to all three Green Deal strategic actions that GREAT focuses on (the 2030 *Biodiversity Strategy*, the Zero-pollution Action Plan and the Climate Change Adaptation Strategy) but not only those. It also provides knowledge for the achievement of *clean*, *reliable and affordable energy* and the *transformation of agriculture and rural areas*.

3.2.2 Key Stakeholders

Some of the major stakeholders of GOS4M are listed in the following:

- Global Mercury Observing System (GMOS)²⁹
- Environment and Climate Change Canada (ECCC)³⁰

²⁶ <u>http://www.gos4m.org/</u>

²⁷ <u>https://gkhub.earthobservations.org/</u>

²⁸ <u>http://www.gos4m.org/kh</u>

²⁹ https://www.gmos.eu/

³⁰ <u>https://open.canada.ca</u>



- Atmospheric Mercury Network (AMNet)³¹
- EuroGEO Showcases: Applications Powered by Europe (e-shape)³²
- Environmental Exposure Assessment Research Infrastructure (EIRENE)³³
- Towards new frontiers for distributed environmental monitoring based on an ecosystem of plant seed-like soft robots (I-seed)³⁴
- UNEP Partnership on Mercury air transport and fate research (UNEP-GMP)³⁵
- Minamata Convention on Mercury (MCM)³⁶

3.3 European Marine Observation and Data Network (EMODNET)

3.3.1 Description

The European Marine Observation and Data Network³⁷ (EMODnet) is an EU public marine data service of the EC (DG MARE), providing a European focal point and trusted source of in situ marine data and data products. It is funded by the European Maritime, Fisheries and Aquaculture Fund (EMFAF). Conversations with the EMOD network have been channelled via GREAT Partner Seascape Belgium, who currently manages the EMODnet Secretariat, as well leading the GREAT Task Force on "Marine Data".

EMODnet is a partnership of more than 120 organisations working together to collect, harmonise, standardise, and share marine in situ data, data products and services in seven thematic disciplines: bathymetry, biology, geology, chemistry, physics, seabed habitats, human activities using FAIR and following INSPIRE geospatial data standards and international ISO standards e.g., for metadata. The collaboration includes neighbouring countries and EU member states, aiming to ensure comprehensive coverage of all European seas.

Until 2019, EMODnet was mainly focusing on European seas. However, its scope has been expanding since then to include data and products for the Caribbean and Caspian Seas as well as many global data sets, particularly in Physics and Biology, and depending on the data, the frequency can be daily, weekly, monthly or yearly.

EMODnet's integrated data and products are utilized by numerous users for scientific research, blue economy operations at sea, marine management, conservation efforts, and to support initiatives like the EU Green Deal, Climate Action, 2030 Biodiversity Strategy, Marine Strategy Framework Directive, and Maritime Spatial Planning Directive, while they also contribute to the clean, reliable and affordable energy, sustainable transport and transition to circular economy strategic actions. Additionally, it plays a crucial role in international ocean governance.

³¹ <u>https://nadp.slh.wisc.edu/networks/atmospheric-mercury-network/</u>

³² <u>https://e-shape.eu</u>

³³ <u>https://www.eirene-ri.eu</u>

³⁴ <u>https://iseedproject.eu/</u>

³⁵ <u>https://www.unep.org/globalmercurypartnership</u>

³⁶https://www.mercuryconvention.org

³⁷ <u>https://emodnet.ec.europa.eu/en</u>



By collaborating with the Copernicus Marine Service³⁸, EMODnet forms a critical part of the envisioned European Digital Twin Ocean, contributing to the EU marine data space and promoting best practices within the global ocean data ecosystem.

3.3.2 Key Stakeholders

EMODnet operates through partnerships encompassing various disciplines, uniting over 120 organizations including universities, research institutes, private entities, government agencies, and marine data centres. These collaborators collect and harmonize marine data, forming a crucial network. To collectively deliver the EU Marine and Green Deal data spaces, EMODnet collaborates closely with the Copernicus Marine Service, as well as with other European (e.g., SeaDataNet) and international initiatives (e.g., the International Council for the Exploration of the Sea³⁹ (ICES) for biological and biogeochemical aspects).

EMODnet Thematic Partners aggregate and harmonize multi-parameter datasets; make data available with searchable metadata as downloadable datasets and/or map layers or through web services (OGC). EMODnet thematic partners produce integrated data products, which are owned by the EU and are therefore published under a CC BY 4.0 license (open data license).

EMODnet Data Ingestion facilitates additional data managers to ingest their marine datasets for further processing, publishing as open data and contributing to applications for society.

The rest of EMODnet's governance structure is described in detail in the GREAT deliverable "D4.1 Phase 1 Governance Requirements and Endorsed Governance Scheme".

3.4 European Plate Observing System European Research Infrastructure Consortium (EPOS ERIC)

3.4.1 Description

The European Plate Observing System⁴⁰ European Research Infrastructure Consortium (EPOS ERIC), which participates in the GREAT project as a beneficiary and is represented by the two affiliated entities, Istituto Nazionale di Geofisica e Vulcanologia (INGV), Italy, and Instytut Geofizyki Polskiej Akademii Nauk (IGF PAS), Poland, is a unique, cutting-edge, multidisciplinary, distributed research infrastructure that facilitates the integrated use of data, data products, and facilities from the solid Earth science community in Europe. With its community-driven approach, which involves scientists, IT experts and decision-makers, it provides a central hub for collecting, processing, and disseminating geological, geophysical, and geodetic data, enabling scientists to collaborate worldwide and gain valuable insights into the Earth's dynamics and processes.

Currently, the EPOS data infrastructure offers data and data services for Europe and beyond from 10 scientific domains: Seismology, Near-Fault Observatories, GNSS Data and Products, Volcano Observations, Satellite Data, Geomagnetic Observations, Anthropogenic Hazards, Geological Information and Modelling, Multi-Scale Laboratories, Tsunami, but it has the potential to include

³⁸ https://marine.copernicus.eu/

³⁹ https://www.ices.dk/Pages/default.aspx

⁴⁰ https://www.epos-eu.org/



new scientific communities benefiting from the use of multidisciplinary geological data and broaden its offer even more.

Through its data portal⁴¹, EPOS offers users from the solid Earth science domain a one-stop shop, enabling them to integrate geospatial data from reliable sources like national monitoring networks and satellite missions. These data serve researchers, educators, policymakers, and stakeholders, addressing challenges like natural hazards, climate change, and energy resources. In addition, the in-house developed data portal software will soon be open-source. Data providers play a crucial role, ensuring scientific relevance and adherence to user needs, aligning with principles of openness and sharing (FAIRness and open Research Data Management (RDM)).

EPOS contributes to the *Climate Change Adaptation Strategy* and to the *clean, reliable and affordable energy* actions.

3.4.2 Key Stakeholders

In total, there are 143 organizations involved in formal structures linked to EPOS being:

- signatories of Thematic Core Services Consortium Agreements
- member of EPOS national consortia or similar initiatives fostering the participation in EPOS
- the designated Representing Entity in EPOS ERIC.

Additionally, EPOS ERIC participates in various European projects in order to strengthen and evolve the infrastructure, develop new functionalities and reach out to new communities:

- Geo-INQUIRE Geosphere INfrastructures for QUestions into Integrated Research⁴²
- DT-GEO A Digital Twin for GEOPhysical extremes⁴³
- Skills4EOSC Skills for the European Open Science Commons: Creating a Training Ecosystem for Open and FAIR Science⁴⁴
- EOSC Future⁴⁵
- ENVRI-FAIR ENVironmental Research Infrastructures building Fair services Accessible for society, Innovation and Research⁴⁶

⁴¹ <u>https://www.epos-eu.org/dataportal</u>

⁴² https://www.geo-inquire.eu/

⁴³ <u>https://dtgeo.eu/</u>

⁴⁴ https://www.skills4eosc.eu/

⁴⁵ <u>https://eoscfuture.eu/</u>

⁴⁶ <u>https://envri.eu/home-envri-fair/</u>



Finally, EPOS ERIC has established several partnerships in Europe and worldwide including with partnerships with: EUMETNET⁴⁷, JERICO-S3⁴⁸, AuScope⁴⁹, EUCENTRE⁵⁰, ECCSEL ERIC⁵¹, EUREF⁵² and EuroGeoSurveys⁵³.

3.5 BioGIS 360

3.5.1 Description

BioGIS 360 is a biodiversity monitoring developed by iptsat, Italy, in collaboration with the Department of Environmental Biology of La Sapienza University of Rome. It serves as a "one-stop shop" data research for those seeking authoritative information on biodiversity at a global or national level.

BioGIS 360 aims to provide support for conducting species and habitat assessments, as well as evaluating potential environmental impacts in decision-making processes related to territorial planning, specifically concerning renewable energy installations like wind and solar energy plants. Its primary objective is to create a Geographic Decision Support System (GDSS), designed to provide essential support to policy makers and regional planners engaged in complex spatial analyses and strategic decisions, particularly with regard to biodiversity considerations.

The system was specially designed to assess the potential impact of wind and solar power plants on the host territory, aiming to mitigate negative effects on biodiversity, such as habitat loss and fragmentation, inappropriate positioning of installations along migration trajectories, or in proximity to nesting sites of birds and other significant species, including bats.

From the strategic actions that the GREAT project focuses on, BioGIS 360 contributes to the 2030 *Biodiversity Strategy* and *Climate Change Adaptation Strategy*.

3.5.2 Key Stakeholders

Key stakeholders of BioGIS 360 are policy makers and regional planners involved in decision making that require biodiversity considerations.

⁴⁷ <u>https://www.eumetnet.eu/</u>

⁴⁸ <u>https://www.jerico-ri.eu/projects/jerico-s3/</u>

⁴⁹ <u>https://www.auscope.org.au/</u>

⁵⁰ <u>https://www.eucentre.it/</u>

⁵¹ <u>https://www.eccsel.org/</u>

⁵² <u>https://euref.org/</u>

⁵³ <u>https://eurogeosurveys.org/</u>



4 Data Inventory (Phase 1)

The Green Deal inventory of high priority data sets and services is one of the main pillars of the Green Deal Data Space and the foundation for the first implementation phase of the GDDS data ecosystem. For its creation, WP5, supported by WP2, has been collecting information and knowledge directly from the GREAT project partners as well as from the relevant stakeholders from their connected communities and networks. In addition, the GREAT project has been engaging with relevant projects and initiatives that carry out their activities in parallel and with other major actors in the EGD landscape, as described in the following sections.

4.1 Approach

The data inventory consists of two main databases: the high priority data set inventory and the data services inventory. More specifically, after the five Reference Use Cases and Initiatives of Phase 1 were selected, they were provided with a questionnaire on all the technical topics that the project covers, the technical blueprint, the governance and the priority data sets. With regard to the data sets, and depending on whether they are a data user or provider, they were asked to provide information on:

- As a data user:
 - The variable(s) required for their study and in which data sets they find them;
 - The characteristics of the data sets, i.e., their spatial (granularity) and temporal resolution (frequency of data availability), formats, data license(s), versioning etc.;
 - Whether they execute any pre-processing/post-processing on them and whether they need to be re-processed after a certain period of time;
 - Their pricing model, i.e., whether they are free of charge for commercial or noncommercial or whether they are proprietary;
 - Whether there are data sets that they would like/need to use but are not available to them and which ones;
- As a data provider:
 - Which data collection(s) they provide;
 - The characteristics of the data collections, i.e., their spatial (granularity) and temporal resolution (frequency of data availability), their timeliness, formats, data license(s), versioning etc.;
 - Whether the data is openly accessible;
 - Whether the produced data are associated with metadata and whether they are discoverable via any web service/API;
 - Whether there is available data documentation;
 - Their pricing model, i.e., whether they are free of charge for commercial or noncommercial or whether they are proprietary;
 - Who maintains them;
 - Whether they produce data collections that are not being published yet and which is the reason for that;



In addition, the use case representatives were asked to fill in a FAIRness checklist⁵⁴ for the data they use or produce as a data user or provider respectively so that their potential for reusability could be assessed. This aspect is one of the prioritisation criteria as described in Section 4.1.1 below.

Apart from the information that was collected through the aforementioned questionnaire, the consortium – and WP5 – organised deep-dive sessions with the use case representatives where the different technical requirements of the use cases and the communities they represent were discussed in depth and a better understanding could be formed. In these sessions, each technical WP (WP3: Technical Blueprint, WP4: Data Governance and Business Models and WP5) had the chance to ask specific questions that concerned their activities respectively and receive information from domain experts. Based on these exchanges, an inventory of the high priority data sets that are required by the Phase 1 use cases was developed and is presented in Section 4.2.2 in short and in Appendix A as a whole.

Following this use case driven approach offers the chance for a deep understanding of the data requirements, processing needs and data gaps of a certain community, and this is considered of high importance for the project. At the same time though, during the creation of the high priority data set inventory, it was clear that by ingesting information only from the specific use cases of Phase 1 would not cover the broader objectives of the EGD strategic actions that the project focuses on. Therefore, in order to document the plethora of the existing European Green Deal related data services, portals and catalogues, the work package started developing a data service inventory simultaneously. This has been populated utilising the existing knowledge of all GREAT partners and the acquired knowledge through the project's interactions with:

- the five Reference Use Cases and Initiatives
- the domain-specific Task Forces: the Marine Task Force, chaired by SeaScape Belgium, and the Water Task Force, chaired by Utrecht University
- a number of relevant European projects and initiatives listed in Table 2:

Project/ initiative name	Short description
AgriDataSpace	Horizon Europe project, Data Space
All Data 4 Green Deal (AD4GD)	Horizon Europe project, Data Space
Biodiversity Building Blocks for policy (B3)	Horizon Europe project
Copernicus Marine Service	Copernicus program
CREODIAS	Copernicus program
Data Portal (EPOS)	Data sharing infrastructure
Data Space 4.0	Digital Europe project, Data Space

Table 2: European initiatives that the GREAT project engaged with during Phase 1

⁵⁴ The FAIRness checklist was created based on the publication <u>How FAIR are your data?</u> by Jones, Sarah, & Grootveld, Marjan.



Data Space for Smart and Sustainable Cities	Digital Europe project, Data Space
and Communities (DS4SSCC)	
Destination Earth	Data sharing infrastructure
Digital Product Passport (CIRPASS)	Digital Europe programme
DSSC	Digital Europe programme
EMODnet	Data sharing infrastructure
ENVRI-FAIR	Horizon 2020 project
EOSC Future	Horizon 2020 project
F.A.I.R. Information cube (FAIRiCUBE)	Horizon Europe project
GeoBon	Data portal by iDiv
GOS4M	GEO flagship
Green Data Hub	Austrian initiative
Green Data Task Force	European Task Force
Green Deal Data Space (Advaneo)	Private data space
Green Digital Coalition (EGDC)	Initiative of companies, supported by the
	European Commission and the European
	Parliament
Iliad Digital Twins of the Ocean	Horizon2020 project
Intelligent Management of Processes, Ethics	Horizon Europe project
and Technology for Urban Safety (IMPETUS)	
Interoperability Network for the Energy	Horizon Europe project
Transition (IntNET)	
Preparatory Data Space for Mobility	Digital Europe project, Data Space
(PrepDSpace4Mobility)	
SeaDataNet	Data sharing infrastructure
Universal Platform Components for Safe Fair	Horizon Europe project
Interoperable Data Exchange, Monetisation	
and Trading (UPCAST)	
Urban Data Space for Green Deal (USAGE)	Horizon Europe project, Data Space
Water Data Management Ecosystem for	Horizon Europe project
Water Data Spaces (Waterverse)	

• a number of relevant stakeholders from the public and private sector that produce and/or require Green Deal data listed in Table 3:

Table 3: Stakeholders that the GREAT project engaged with during Phase 1

Stakeholder name	Short description
Airbus	Private company
Austrian Institute of Technology	Research institute
City of Thessaloniki	Public sector, municipality



Climate Data Analysis	Research institute
CloudFerro	Private company
CNR	Public research institution
CzechGlobe	Public research institution
DG AGRI	EC Directorate-General
DG CLIMA	EC Directorate-General
DG Connect	EC Directorate-General
DG ENERGY	EC Directorate-General
DG MARE	EC Directorate-General
DG MOVE	EC Directorate-General
ECMWF	Research institute and a 24/7 operational
	service
EEA	EU Agency
EPOS	Research infrastructure
EUMETSAT	Intergovernmental organisation
Eurogeographics	International non-profit organisation
DG ENV	EC Directorate-General
Eurostat	EC Directorate-General
GAF	Private company
Geosystems Hellas	Private company
GHGSat	Private company
Gisat	Private company
Hydrologic	Private company
iDiV	Research institute
INGV	Research institute
Ipsat	Private company
JRC	Research institute
Mercator Ocean International	International non-profit organisation
Microsoft	Private company
Onecub	Private company
Plan4all	Non-profit association
Planet	Private company
rasdaman GmbH	Private company
REA	EU Agency
Seascape	Private company
Spire	Private company
UFZ	University
University of Utrecht	University
VLIZ	Research institute
WMO	UN agency



The engagement strategy and activities are described in detail in the WP2 deliverable "D2.1: Dissemination, Strategy, Plan & Materials".

Both the data sets and services inventory will continue being populated in the second phase of the project with the information acquired from the analysis of the new Reference Use Cases and the engagement with additional initiatives and stakeholders respectively.

4.1.1 Prioritisation criteria and method

As the goal of WP5 is to create an expandable core of high priority data sets for the first implementation of the Green Deal data space, it was foreseen that the high priority data sets and services inventories will present data sets and services in a prioritised way respectively. To achieve that, a number of prioritisation criteria were selected during the proposal stage, which are:

- the relevance of the data sets to several EGD objectives and
- the relevance of the data sets to the data requirements of the Reference Use Cases
- other criteria, such as FAIR maturity, compliance with interoperability standards, readiness for sharing, and data quality.

Through the work performed in this work package, including all the interactions with the References Use Cases and the external stakeholders, which contributed significantly to getting a better understanding of the Green Deal landscape, the prioritisation approach that has been chosen for the inventories is as follows:

<u>High Priority Data Sets inventory</u>: all input data sets listed in this inventory are considered of high priority as they are the ones provided by the Reference Use Cases as *required* data for achieving their objectives. In addition, the data products, produced by the use cases, are also considered of high priority since in a potential onboarding of the Reference Use Cases in the Green Deal data space these data would be their contribution as a data provider.

<u>High Priority Data Services inventory</u>: the list of data services was prioritised based on the following criteria:

- Criterion 1: Relevance to the Reference Use Cases
- *Criterion 2*: Relevance to the strategic actions that GREAT focuses on (2030 Biodiversity Strategy, Zero Pollution Action Plan, Climate Change Adaptation Strategy) and their objectives
- *Criterion* 3: Relevance to EGD initiatives, programmes etc.
- *Criterion* 4: Data offering completeness (spatial and temporal coverage)
- Criterion 5: FAIRness, business models etc.

More specifically, each service was given a score from 1 (being the lowest score) to 5 (being the highest) for each one of the five prioritisation criteria. As some criteria as considered of higher importance than other ones, a weighted average was applied in order to calculate the overall prioritisation score based on the following weights:



Table 4: Weights per prioritisation criterion for the calculation of the overall prioritisation score

Criterion #	Weight (%)
Criterion 1	25%
Criterion 2	25%
Criterion 3	20%
Criterion 4	15%
Criterion 5	15%

Based on the resulting overall prioritisation score, the data services were sorted from highest to lowest priority.

It should be noted that during Phase 1 the prioritisation was performed only by certain people within WP5, but in order to have a more objective result, in Phase 2 the process will include additional project members, not only from WP5 but also from other WPs, and the prioritisation order might need to be updated.

4.2 High priority data sets inventory

4.2.1 Structure and organisation

The envisioned structure and organization of the Green Deal high priority data set inventory is a comprehensive framework designed to efficiently catalogue, categorise, and manage a large number of data sets relevant to the Green Deal. The requirements for the structure of the catalogue were identified as follows:

- it should be capable of representing multiple data types related to the Green Deal;
- it should be easily extendable with new common metadata fields;
- it should be easily accessible and queryable via web-browsers;
- it should not represent and reproduce existing catalogues;
- it should include data sets according to their priority for the Reference Use Cases and the EGD objectives.

Specifically, the reflection of various meta data types in various disciplines is a big challenge due to the highly diverse landscape of data type specifications and standards that must be considered within the GDDS initiative. Aligned with modern technological capabilities and needs, the GDDS suggests a data inventory structure that is community driven which means that the initial inventory and its structure may be extended or changed by future users of the GDDS.

In the initial inventory, the data sets are added with 20 metadata attributes called *tags* that contain basic information about the data set. 4 initial tags are mandatory upon adding a data set to the inventory, whereas the other 16 tags are conditionally mandatory or fully optional. The mandatory tags are necessary to identify, find and assess suitability of any given dataset for a user of the GDDS. Conditionally mandatory tags can only be filled for a certain type of dataset that has a spatial or temporal component which elaborates on the assessment of a user for the suitability of



a dataset for their needs which also links to a documentation to provide more in-depth information. Optional tags are a good indication for usability, accessibility or availability of certain datasets that are in the inventory. Finally, the HVD categories and Essential variables tags can provide an indication of missing data. The selection of the tags themselves originates from the necessity to reflect key attributes such as FAIR use, format, spatiotemporal assets and associated HVD categories.

The list of tags is presented in the following:

Table 5: High priority data set inventory tags

Tags	Mandatory/optional
Dataset/service name	Always mandatory
Data owner	Always mandatory
Provider Name	Always mandatory
data format	Always mandatory
Free of charge	Always mandatory
Data source/generation type	Optional
Spatial Resolution x,y,z	Conditionally mandatory
number of dimensions	Conditionally mandatory
Spatial Extent	Conditionally mandatory
Temporal Extent	Conditionally mandatory
HVD Category	Optional
Essential Variable category	Optional
Essential Variables	Optional
License	Optional
Machine-readability	Optional
Availability (API, on-request)	Optional
Metadata Standard	Optional
Data linking Documentation	Conditionally mandatory
Timeliness / Frequency of	Optional
acquisition	
Country of origin/storage	Optional

The tags are an initial foundation for the initial GDDS inventory and are subject to contribution of the future community of practise of the GDDS. This means that these tags are not fixed but can be extended by the community to fulfil additional upcoming requirements. The inventory is initiated with information provided within the GREAT project, but nevertheless can be transferred technologically to other catalogue systems anytime. The preferred and proposed solution is a solution where users can search, add and manage the data sets in the GDDS. This can also include adding data sets from other catalogue services through common standards. The GDDS inventory



in the background should be able to query based on the above-mentioned tags while being interoperable with other catalogues.

To ensure efficient and effective data management within inventory, suitable search mechanisms are crucial for locating and populating the data set catalogue. Given the diverse range of data types and the need to support community-driven extensions, the search mechanisms should be flexible, scalable, and user-friendly. One suitable approach is to incorporate keyword-based search functionality, allowing users to search for data sets based on relevant terms and concepts. This can include full-text search capabilities that scan data set titles, descriptions, and associated metadata tags. Additionally, the inventory could benefit from advanced search filters, enabling users to refine their queries based on specific criteria such as data type, date range, geographic coverage, or data provider, which are implemented as tags in the inventory. Implementing faceted search, where users can dynamically explore and filter data sets based on different attributes and categories, can enhance the discoverability and accessibility of relevant data. Furthermore, incorporating semantic search techniques, leveraging ontologies and linked data, can enable more intelligent and contextaware search capabilities, assisting users in finding data sets based on their meaning and relationships. These search mechanisms should be integrated into the dedicated solution that allows online web interface of the GDDS, tools to explore, discover, and contribute data sets to the inventory while ensuring interoperability with other catalogue systems and standard-based data exchange.

The current high priority data set inventory is a simple table format that collects the information about the key data sets provided by the five Reference Use Cases and Initiatives of Phase 1 – as described in Section 4.2.

4.2.2 List of Phase 1 high priority data sets

The Phase 1 Reference Use Cases of the GREAT project have provided the first set of high priority data sets, which have been added to the data sets inventory. Specifically, the use cases from CNR - GOS4M, Utrecht University – Global Hydrology and iptsat – BioGIS 360 have added specific data sets that are of high priority such as the Community Atmospheric Model Chemistry output or the Flux and State variables of the output of the PCR-GLOBWB global water resources model and data that supports decision making based on biodiversity indicators connected to renewable energy sources (see Table 6 or more detailed info on data sets and data owners – the full inventory can be found in the Appendix A). It is noted that this is not an exhaustive list of the data sets that the aforementioned communities required but rather the ones provided to the GREAT team during the engagement activities.

	GOS4M	
	Data sets	Data owner
Input data	Arctic Monitoring and Assessment	Groningen Digital Competence Centre
	Programme - Geospatially distributed	(University of Groningen)
	(gridded) global mercury emissions to air	

Table 6: Phase 1 high priority data sets inventory



	from onthrono conic courses in 2015	
	from anthropogenic sources in 2015	
	(HgO, Hg(II) and HgP)	
	EDGAR Global Toxic Pollutants	European Commission, Joint Research
	Emissions - Hg_G, Hg_D and Hg_P	Centre, International Energy Agency
	Community Atmosphere Model with	University Corporation for
	Chemistry (CAM-chem)	Atmospheric Research
	ECMWF Reanalysis v5 (ERA5)	ECMWF
	Copernicus Global Land Service - Land	JRC
	Cover	
	GOS4M Measurements of mercury and	CNR
	associated parameters	
Data	Hermes Decision Support System	CNR
products	(HDSS) products	
	Hydrology Use C	ases
	Data sets	Data owner
Input data	Global 30 Arc-Second Elevation	United States Geological Survey
-	(GTOPO30)	Ç ,
	HydroSHEDS Core layers (version 1)	World Wildlife Fund US
	Hydro1k	United States Geological Survey
	Global Land Cover Characterization	United States Geological Survey
	Мар	
	MIRCA2000	University of Frankfurt
	FAO/UNESCO Soil Map of the World	Food and Agriculture Organization
	GLobal HYdrogeology MaPS	Joint Research Centre
	(GLHYMPS) of permeability and	
	porosity	
	Land Surface Reflectance - GLS2010	United States Geological Survey
	AQUASTAT	Food and Agriculture Organization
	MERIT DEM	University of Tokio
	Copernicus Global Land Cover Lavers	European Commission: EEA
	Global Lakes and Wetlands Database	World Wildlife Fund
	Spatial Production Allocation Model	International Food Policy Research
		Institute (IFPRI)
	RiceAtlas	International Rice Research Institute
		(IRRI)
	SoilGrids250m 2017	ISRIC - World Soil Information
Data	PCR-GLOBWB 2 output state and flux	Utrecht University
products	variables	
	BioGIS360	
	Data sets	Data owner
	IUCN Red List of threatened species	International Union for Conservation



Input	Ramsar Sites Information Service	Ramsar Convention					
data	World protected areas	protected planet					
	global solar atlas	World Bank Group					
	global wind atlas	World Bank Group					
	Spatial distribution of species	EEA					
	conservation status trends at Member						
	State level represented in a 10 x 10 km						
	grid						
	Corine Land Cover	EEA					
	Sentinel 2 L2A	ESA					

The Reference initiatives of EMODNET and the European Plate Observing System ERIC, having mainly the role of the data provider, have provided data services (portals and catalogues) that have been added to the data services inventory and contribute with data that are associated with the three strategic actions, 2030 Biodiversity Strategy, Zero Pollution Action Plan, Climate Change Adaptation Strategy

When comparing access policy of environmental in-situ observations, model output and organized data catalogues it is specifically noteworthy that in all Phase 1 use cases there is a gradient in data access facilitation. While access to in-situ measured observations is usually not facilitated, the model output and specifically organized data catalogues such as EMODNET and the European Plate Observing System ERIC facilitate access and usage of the available data sets.

Nevertheless, most of the data can be now directly downloaded and API access and machine to machine communication is enabled mostly for the model output and the organized catalogues. All of the provided data sets by the use cases expose sufficient metadata to identify and analyse them under the FAIR principles. Commercial data sources have not been part of the investigation in Phase 1, nevertheless, it is a goal to include the metadata of commercial data sets in the inventory.

4.2.3 Data gaps

The INSPIRE directive has significantly transformed access to geodata by establishing a harmonized framework for sharing and integrating spatial information across Europe. By harmonizing data specifications, standards, and infrastructure, INSPIRE has streamlined access to geodata, making it more accessible and usable for a wide range of applications, including environmental management, urban planning, and public services. The initiative has fostered collaboration and cooperation among European countries, resulting in improved data discovery, access, and integration, ultimately enhancing the effectiveness and efficiency of geospatial information management across the region.

However, certain data sets, concerning the European Green Deal, collected by the EU member states, are not yet available in a unified a manner similar to data that is considered in the INSPIRE directive.



During the first phase of the GREAT project, several key data sets attracted attention due to their access policies and importance within the GDDS mainly beyond the scope of the INSPIRE and HVD directives. Nevertheless, i.e., INSPIRE may serve as an example that may be extended to other key datasets and domains. The following list reflects the current preliminary, non-exhaustive status of identified key data gaps concerning GREAT:

- Local data about water reservoirs (gauge data, temperature, streamflow)
- Near real time in-situ meteorological observations in a unified cross-border specification
- Near real time Electric Energy consumption of regions and its live CO2 footprint
- High-resolution gridded information about biodiversity
- Unified species occurrence data, including citizen science data
- Indication of data set quality level and quality control
- Socio-economic statistics that are not reported standardised such as: income inequality and migration and integration statistics

4.3 High priority data services inventory

4.3.1 Structure and organisation

The high priority data services inventory, on the other hand, has a much simpler structure and organisation that basically serves the purpose of listing the Green Deal relevant data services, catalogues, portals etc. When a new entry is added, the following information are provided:

- Identification number
- (Editor)
- Data service Information
 - Service name (and service owner)
 - URL to the API of the service
- Access information
 - Type of endpoint/access technology
- the High Value Data set categories that it belongs to (TRUE/FALSE)
- prioritisation information (score per prioritisation criterion and overall score)

The Phase 1 high priority data services inventory has been populated by WP5 based on the information acquired from the GREAT consortium and the engagement with external stakeholders and initiatives from the Green Deal domain. However, it is within the Phase 2 plans to enable additions of further data services by persons external to the project, i.e., scientists, stakeholders etc. active in specific Green Deal domains. That would help the project ensure that each domain that the GREAT project focuses on is covered to a sufficient degree.

4.3.2 List of Phase 1 high priority data services

The following table presents the first 20 entries of the high priority data services inventory, while the entire list, which contains 77 entries, is attached in Appendix B.



 Table 7: Part of Phase 1 high priority data services inventory

			Overall
ID	Service name	URL to API	prioritisation
			score
1	Copernicus Global Land Service	https://land.copernicus.eu/global/	4.75
		products/	
2	Joint Research Centre Data	https://data.jrc.ec.europa.eu/data	4.35
	Catalogue	set	
3	Copernicus Atmosphere	https://ads.atmosphere.copernicu	4.3
	Monitoring Service	s.eu/cdsapp#!/search?type=datas	
		<u>et</u>	
4	Copernicus Open Access Hub	https://scihub.copernicus.eu/	4.1
5	NOAA National Centers for	https://www.ncei.noaa.gov/produ	4.05
	Environmental Information -	<u>cts</u>	
	Paleoclimatology Data		
6	Climate Data Store	https://cds.climate.copernicus.eu/	3.8
		<u>api-how-to</u>	
7	GBIF	https://www.gbif.org/	3.7
8	GOS4M Catalog	https://sdi.iia.cnr.it/gos4mcat/srv	3.65
		<u>/eng/catalog.search#/search</u>	
9	GEOSS Portal	https://www.geoportal.org/?m:ac	3.55
		tiveLayerTileId=osm&f:dataSourc	
		<u>e=dab</u>	
10	Earthref - Earth Reference Data	https://earthref.org/#gsc.tab=0	3.55
	and models		
11	Copernicus Emergency Services		3.5
12	AEMET	https://www.aemet.es/en/eltiem	3.5
		po/observacion	
13	Pangea (Data Publisher for Earth	https://pangaea.de/	3.5
	& Environmental Science)		
14	MISTRALS database	http://mistrals.sedoo.fr/	3.5
15	EDGAR - Emissions Database for	https://edgar.jrc.ec.europa.eu/emi	3.45
	Global Atmospheric Research	ssions_data_and_maps	
16	LUCAS	https://ec.europa.eu/eurostat/we	3.35
		b/lucas/data/database	0.05
17	KNMI data platform	https://dataplatform.knmi.nl/orga	3.35
		nization/knmi	0.05
18	ACTRIS - Aerosol Clouds and	https://actris.nilu.no/	3.35
	Irace gases Research		
	Intrastructure		



19	Copernicus Marine Service	https://data.marine.copernicus.eu	3.3
		/products	
20	EEA Data Hub	https://www.eea.europa.eu/en/d	3.3
		<u>atahub</u>	



5 Conclusions and Recommendations

The activities within WP5 during Phase 1 were focused on the identification of an initial set of high priority data sets, gaps and services based on the first Reference Use Cases and Initiatives (Large-Scale Hydrology (LSH), Global Observation System for Mercury (GOS4M), European Marine Observation and Data Network (EMODNET), European Plate Observing System European Research Infrastructure Consortium (EPOS ERIC) and BioGIS 360) and the engagement with stakeholders and initiatives from the Green Deal domain, and create a data inventory with all collected information. The data inventory consists of two main databases: the high priority data set inventory and the data services inventory. The former contains a non-exhaustive list of the use case input data as well as the data products they offer. They are all considered of high priority as they are the ones required for achieving their objectives. The latter presents a list of Green Deal relevant data services, catalogues, portals etc., which is prioritised and sorted based on certain prioritisation criteria.

Based on the current project status the following action points for the future roadmap have been identified:

- Next to actual data sets historical data as well as forecast data are essential (e.g., mean yearly streamflow predicted by a hydrological model for 2050) in order to look into the past and to predict future scenarios.
- Next to actual data, near-real-time data streams are essential to get insights into the actual changing state and to update and improve forecast models.
- Multiple data representations with standardised data formats like the following need to be supported:
 - static and temporal (for temporal fixed timestep and variable timestep),
 - point locations (objects) and
 - areal coverages (for the latter raster, vector, i.e., multiple representations and multiple dimensions, for data cubes)
- Next to the possibility of accessing multiple data formats (e.g., by near-real-time conversion) different access methods need to be supported (download, web service, APIs, etc.).
- Data search should not be limited by the actual metadata attributes, extensions towards a semantic search mechanism needs to be supported in the future.
- Data search, access and processing for data distributed at multiple locations needs to be supported.
- Next to the easy access of free and open data commercial data shall be findable and usable via standardised payment methods and models.
- Data sets need to be able to be traceable to ensure data integrity and quality.

In Phase 2, WP5 plans to expand the current high priority data sets and services inventory with input from additional - more inter-disciplinary - reference use cases and interactions with stakeholders from the Green Deal domain, including Destination Earth, and will ensure that data



sets required to achieve the Green Deal policy objectives are sufficiently included. In addition, the currently under-represented HVD categories are going to be investigated in more detail and high priority data sets from those will be added into the inventory.



Appendix A. High priority data sets inventory – Phase 1

Appendix A provides the full inventory of high priority data sets, as this was described in Section 4.2.2.

Table 8: Phase 1 high priority data sets inventory

Reference Use Case Dataset ID	Dataset name	Data owner	Provider Name	Data format	Free of charge	Data source/generation type	Spatial Resolution x,y,z	Number of dimensions	Spatial Extent	Temporal Extent	HVD Category	Essential Variable category	Essential Variables	License	Machine-readability	Availability (API, on- request)	Metadata Standard	Data linking Documentation	Timeliness/Frequency of acquisition	Country of origin/storage
Global Observation System for Mercury	ERA5	ECMWF	ECMWF	netCDF; GRIB	TRUE	model output	0.25°, 0.25°, pressure levels	3	global	1940 - now	Meteoro logical	Climate	Precipitatio n, Pressure, Radiation budget, Temperatur e, Water vapour, Wind speed and direction, Upper-air, Earth radiation budget, Lightning Water vapor, Clouds, Atmospheri c compositio n	Licence to use Coperni cus Product s	TRUE	ΑΡΙ	ISO 19115:2 003/19 139	https://c onfluenc e.ecmwf .int/displ ay/CKB/ ERA5%3 A+data+ docume ntation	daily	Europ



	2 AMAP	Groninger Digital Competer ce Centre	nGroningen Digital Competenc e Centre	Gridded - unknow n	TRUE	model output	0.25°, 0.25°, 0	3	global	2010; 2015	Meteoro logical	Climate	Aerosols	CC-BY	TRUE	ΗΤΤΡ	oai_dc	https:// datavers e.nl/dat aset.xht ml?persi stentId= doi:10.3 4894/S Z2KOI	5 years	Nethe rlands
	3 EDGAR Global Toxic Pollutar s Emissio s	European Commissi on, Joint nt Research Centre, n Internatio nal Energy Agency	European Commission	netCDF	TRUE	model output	0.1°, 0.1°	2	global	1970- 2012	Meteoro logical	Climate	Aerosols	open source + attributi on	TRUE	HTTP	NA	https:// edgar.jrc .ec.euro pa.eu/da taset_4t ox2	irregular	Europ e
	4 CAM- Chem	UCAR	UCAR	unknow n	TRUE	model output	-	unknow n	global	2001- 2020	Meteoro logical	Climate	Atmospheri c Compositio n, Aerosols	CC BY 4.0	TRUE	НТТР	NA	https:// www.ac om.ucar. edu/cam - chem/ca m- chem.sh tml	6-hourly	USA
	5 GOS4M HERME model output	1 CNR S	CNR	netCDF	TRUE	model output	unknow n	2	Europe	unknow n	Meteoro logical	Climate	Hydrology, Aerosols , Carbon dioxide, methane and other greenhouse gases	NA	TRUE	HTTP	https:// www.iso tc211.or g/2005/ gmd/	https://s di.iia.cnr. it/herme <u>s/</u>	NA	Italy
Hydrolog	6 PCR- GLOBV B 2 output	NA V	Utrecht University	NA	TRUE	model output	user- defined	2	global	user- defined	Earth Observa tion &	Geodive rsity	- Hydrology	<u>GPL-3.0</u> license	True	online	NA	<u>https://</u> g <u>ithub.c</u> om/UU- Hydro/P	NA	Nethe rlands



sta flu vai	ate and Ix riable										environ ment							<u>CR-</u> GLOBW B_model		
7 GT 0(TOPO3 (DEM)	USGS	USGS; ESRI	GeoTiff	TRUE	digital elevatio n	30 arc seconds	2	global	NA	Earth Observa tion & environ ment	Geodive rsity	Hydrology, Landform distribution	Creative Commo ns Attributi on 4.0 Internati onal	True	API	FGDC- STD- 001- 1998	https:// www.us gs.gov/c enters/e ros/scie nce/usg s-eros- archive- digital- elevatio n- global- 30-arc- second- elevatio n- gtopo30	irregular	USA
8 Hy ED	ydroSH DS v1	WWF US	hydrosheds. org	GeoTiff	True	river network	3 arc seconds	2	global	NA	Earth Observa tion & environ ment	Geodive rsity	Hydrology	HYDRO SHEDS VERSIO N 1 - LICENS E AGREE MENT	True	online	FGDC Standar d Metadat a XML	https:// www.hy droshed s.org/	NA	USA
9 Hy	ydro1k	USGS	USGS	GeoTiff	TRUE	topogra phically derived drainage network s & ancillary layers	30 arc seconds	2	global	NA	Earth Observa tion & environ ment	Geodive rsity	Hydrology	No copyrigh t restricti on	True	API	NA	https:// www.us gs.gov/c enters/e ros/scie nce/usg s-eros- archive- digital-	irregular	USA



																		<u>elevatio</u> <u>n-</u> hydro1k		
10 (r	GLCC nap	USGS	USGS	GeoTiff	TRUE	land cover	1km	2	global	1992	Earth Observa tion & environ ment	Agricult ure	Landform distribution, Land use	No copyrigh t restricti on	True	ΑΡΙ	ISO 19115	<u>https://</u> doi.org/ 10.5066 /F7GB2 30D	one- time acquisiti on	USA
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12 F N	AO Soil Map	FAO	FAO	PDF / JPG	TRUE	soil map	vector data	2	global	1977	Earth Observa tion & environ ment	Geodive rsity	Soil	CC BY- NC-SA 3.0	True	online	ISO191 15	https:// www.fa o.org/so ils- portal/d ata- hub/soil -maps- and- databas es/faou nesco- soil- map-of- the- world/e n/	irregular	intern ational



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Appendix B. High priority data services inventory – Phase 1

Appendix B provides the full inventory of high priority data services, sorted from highest to lowest priority.

 Table 9: Phase 1 high priority data services inventory

ID	Data Service Infor	mation	Access information		High Va	lue Data	asets ca	tegories		(s	core from	Priorit 1-5, witl	isation n 1 being	the lowe	st)
#	Service name	URL to API	Endpoint (access) technology	Geospatial	Earth Observation & Environment	Meteorological	Statistics	Companies & company ownership	Mobility	Relevance to the Reference Use Cases	Relevance to the strategic actions that GREAT focuses on	Relevance to EGD initiatives, programmes etc.	Data offering completeness (coverage)	FAIRness, business models etc.	Overall score
3	Copernicus Global Land Service	https://land.copern icus.eu/global/prod ucts/	CDS API		TRUE					5	4	5	5	5	4.75
10	Joint Research Centre Data Catalogue	https://data.jrc.ec.e uropa.eu/dataset	-	TRUE	TRUE	TRUE	TRUE		TRUE	4	4	5	4	5	4.35
5	Copernicus Atmosphere Monitoring Service	https://ads.atmosp here.copernicus.eu /cdsapp#!/search?t ype=dataset	CDS API		TRUE	TRUE				4	4	4	5	5	4.3
23	Copernicus Open Access Hub	https://scihub.cope rnicus.eu/	OpenSearch (RESTful API)		TRUE					3	5	3	5	5	4.1
73	NOAA National Centers for Environmental Information - Paleoclimatology Data	https://www.ncei.n oaa.gov/products	FTP, other		TRUE	TRUE				4	5	3	4	4	4.05
1	Climate Data Store	https://cds.climate. copernicus.eu/api- how-to	CDS API		TRUE	TRUE				2	4	4	5	5	3.8
14	GBIF	https://www.gbif.o rg/		TRUE	TRUE		TRUE			3	4	3	4	5	3.7



16	GOS4M Catalog	https://sdi.iia.cnr.it /gos4mcat/srv/eng /catalog.search#/se arch		TRUE		TRUE			2	4	4	4	5	3.65
8	GEOSS Portal	https://www.geop ortal.org/?m:active LayerTileId=osm&f: dataSource=dab	REST API	TRUE	TRUE		TRUE		3	5	4	4	1	3.55
82	Earthref - Earth Reference Data and models	https://earthref.org /#gsc.tab=0	FIESTA API	TRUE	TRUE	TRUE	TRUE		4	3	3	3	5	3.55
2	Copernicus Emergency Services		CDS API	TRUE	TRUE				1	3	5	5	5	3.5
53	AEMET	https://www.aemet .es/en/eltiempo/ob <u>servacion</u>	OpenDAta Rest API			TRUE			3	3	4	3	5	3.5
75	Pangea (Data Publisher for Earth & Environmental Science)	<u>https://pangaea.de</u> /	Java API	TRUE	TRUE				4	4	3	1	5	3.5
87	MISTRALS database	http://mistrals.sedo o.fr/	OpenDAP, NetCDF		TRUE				4	3	2	4	5	3.5
21	EDGAR - Emissions Database for Global Atmospheric Research	https://edgar.jrc.ec. europa.eu/emission s_data_and_maps				TRUE			2	4	3	4	5	3.45
40	LUCAS	https://ec.europa.e u/eurostat/web/luc as/data/database	-				TRUE		4	3	2	3	5	3.35
49	KNMI data platform	https://dataplatfor m.knmi.nl/organizat ion/knmi	NetCDF			TRUE			3	3	4	2	5	3.35
84	ACTRIS - Aerosol Clouds and Trace gases Research Infrastructure	https://actris.nilu.n o/	REST API	TRUE		TRUE			3	3	4	4	3	3.35
4	Copernicus Marine Service	https://data.marine .copernicus.eu/pro ducts			TRUE				1	3	4	5	5	3.3



7	EEA Data Hub	https://www.eea.e uropa.eu/en/datah ub	-	TRUE	TRUE				2	4	3	3	5	3.3
44	ECA&D	https://www.ecad. eu/dailydata/index. php	INQC API			TRUE			2	4	3	3	5	3.3
20	Arctic Monitoring and Assessment Programme (AMAP)	<u>https://www.amap. no/data</u>					TRUE		3	4	3	2	4	3.25
103	Key Biodiversity Areas	https://www.keybi odiversityareas.org /kba-data	Request	TRUE	TRUE				3	3	2	4	5	3.25
104	AQUASTAT	http://www.fao.org /nr/water/aquastat /main/index.stm		TRUE	TRUE				3	2	4	3	5	3.25
11	EMODNET		ERDDAP, REST API, THREDDS	TRUE	TRUE				2	3	3	4	5	3.2
12	Blue-Cloud Data Discovery & Access Service	https://data.blue- cloud.org			TRUE				1	4	3	4	5	3.2
22	Community Atmosphere Model with Chemistry (CAM-chem)	https://www.acom. ucar.edu/cam- chem/cam- chem.shtml				TRUE			2	4	4	5	1	3.2
6	WEKEO DIAS		HDA API		TRUE				2	4	3	4	3	3.15
17	CREO DIAS	https://explore.cre odias.eu/	REST API		TRUE				3	3	3	4	3	3.15
45	GRDC	https://portal.grdc. bafg.de/application s/public.html?publi cuser=PublicUser# dataDownload/Ho me	NetCDF	TRUE	TRUE				3	2	2	5	5	3.15
24	Copernicus Data Access Service	https://dataspace.c opernicus.eu/	CDS API		TRUE	TRUE			2	2	3	5	5	3.1



31	USGS Earth Explorer	https://earthexplor er.usgs.gov/	M2M API		TRUE				4	3	3		5	3.1
18	Eurostat	https://ec.europa.e u/eurostat/data/da tabase	API SDMX 2.1				TRUE		1	5	2	3	5	3.1
85	ICOS - Integrated Carbon Observation System	https://www.icos- cp.eu/	SPARQL	TRUE		TRUE			3	3	2	3	5	3.1
25	ECMWF forecasts		CDS API			TRUE			2	3	3	5	3	3.05
80	IEDA - Interdisciplinary Earth Data Alliance	<u>https://www.iedad</u> ata.org/	NA (temporarily)						3	2	3	3	5	3.05
28	Destination Earth Data Lake (EUMETSAT)				TRUE	TRUE			2	3	2	4	5	3
98	DataOne	<u>https://search.data</u> one.org/data/query =IEDA	REST API	TRUE	TRUE		TRUE		3	3	3	2	4	3
51	re3data	https://www.re3da ta.org/	NetCDF, SOAP,			TRUE			1	4	4	1	5	2.95
63	ISRIC data hub (soil)	<u>https://rest.isric.or</u> g/soilgrids/v2.0/do <u>cs</u>	REST API, FTP API	TRUE					3	2	3	2	5	2.9
77	PDOK	<u>https://www.pdok.</u> <u>nl/datasets</u>	CSW API	TRUE					2	3	3	2	5	2.9
26	European Soil data centre	https://esdac.jrc.ec. europa.eu/resource -type/datasets	ISO 19115 ?		TRUE				2	3	2	3	5	2.85
74	ArcGIS OpenData	https://hub.arcgis.c om/search	REST API	TRUE	TRUE				2	2	3	3	5	2.8



93	LifeWatch - infrastructure for	https://www.lifewa	REST API ? (HTTP,											
	biodiversity organisation and	tch.eu/	Orchestra)											
	Ecosystem								_				_	
				TRUE	TRUE		TRUE		4	3	2	1	3	2.75
95	OCHA - Centre for humanitaria	https://data.humda	REST API						-		-		_	
	Data	ta.org/		TRUE			TRUE		2	2	2	4	5	2.75
86	ARISE - Atmospheric dynamics	http://arise-												
	Research Infrastructure in	project.eu/							3	Л	2	3	1	2 75
	Europe				TROL				5	4	2	5	T	2.75
	· · · · · · · · · · · · · · · · · · ·													
47	Worldbank EU	https://data.worldb	REST API						1	0	2	4	F	0.7
		ank.org/			TRUE				T	Z	3	4	Э	2.7
64	OpenLandMap	https://api.openlan	_											
		dmap.org/							2	3	2	2	5	27
				TROL	INOL				2	0	2	2	5	2.7
66	ECOMET	https://www.ecom	-											
		et.eu/ecomet-				TRUE			3	3	3		4	2.7
		catalogue/catalogu							-	-	_		-	
		e-search-tool						 						
83	IODP - International Ocean	https://web.iodp.ta	REST API											
	Discovery Program	mu.edu/janusweb/l		TRUE	TRUE		TRUE		1	2	3	4	5	2.7
		inks/links_all.shtml												
88	NIOZ - Royal Netherlands	https://dataverse.ni		TRUF	TRUF				2	3	2	2	5	2.7
	Institute for Sea Research	oz.nl/dataverse/doi							_	-	_	_	-	
43	SeaDataNET	https://www.seada	SOAP, NetCDF											
		tanet.org/Products			TRUE				1	3	3	3	4	2.65
		<u>#/search</u>												
38	GEE	https://gee.stac.clo	REST ΔΡΙ STΔC											
50	GEE	ud/	REST ALL, STAC	TRUE	TRUE				1	3	2	5	3	2.6
		<u>uu/</u>												
39	European climate and health	https://sdi.eea.euro	-											
	observatory (EEA)	pa.eu/catalogue/cli												
		<u>mate-</u>			TRUE				1	3	2	3	5	2.6
		health/eng/catalog.												
		search#/home												



13	EPOS - European plate observing system	https://www.ics- c.epos-eu.org/	GLASS, OpenSearch	TRUE	TRUE			2	1	3	3	5	2.55
100	EU4waterdata (water and data in Eastern Partner Countries)	www.eu4waterdata .eu		TRUE	TRUE			3	3	3	2	1	2.55
52	EODC data	https://eomex.eodc .eu/api	OpenEO API		TRUE			1	2	3	4	3	2.4
89	EMSO - European Multidisciplinary Seafloor and water colin Observatory	https://data.emso.e <u>u/home</u>	REST API (EMSO ERIC)		TRUE			1	2	3	3	4	2.4
90	JERICO - Coastal marine system change appraisal	<u>https://www.jerico</u> -ri.eu/jerico-ri- catalogue/#/map	NetCDF	TRUE	TRUE			1	2	3	3	4	2.4
19	GeoBon	https://portal.geob on.org/home			TRUE			2	3	1	2	4	2.35
37	EGDI – The European Geological Data Infrastructure	https://www.europ e-geology.eu/			TRUE			2	1	2	3	5	2.35
79	ORFEUS - Observatories and Research Facilities for European Seismology	<u>https://orfeus-</u> eu.org/	<u>https://orfeus-</u> eu.org/data/eida/ webservices/	TRUE	TRUE			1	2	2	3	5	2.35
72	UTM-CSIC Data Centre	http://data.utm.csic .es/portal/	REST API	TRUE	TRUE			1	2	3	2	4	2.25
65	Terrascope	https://docs.terrasc ope.be/#/Develope rs/WebServices/Te rraCatalogue/STAC API	OpenSearch and STAC		TRUE			1	2	2	4	3	2.2
78	NLOG	<u>https://www.nlog.n</u> l/datacenter/	WFS, WMS	TRUE		TRUE	TRUE	1	2	2	2	5	2.2
42	BODC	https://www.bodc. ac.uk/data/bodc_d atabase/nodb/	NetCDF		TRUE			1	2	2	3	4	2.2
94	Espon - European knowledge base related to territorial dynamics	https://www.espon .eu/		TRUE		TRUE		1	2	2	3	4	2.2



9	INSPIRE	<u>https://inspire-</u> geoportal.ec.europa .eu/pdv_home.html	<u>a</u>	TRUE	TRUE			1	2	4	1	3	2.15
91	Danubius	https://gis.geoeco mar.ro/danubius/d ataportal/menu.ph p	REST API	TRUE	TRUE			1	2	3	1	4	2.1
15	FAO	<u>https://www.fao.or</u> g/faostat/en/#data	REST, SOAP		TRUE	TRUE		1	2	2	2	4	2.05
92	OSPAR - Natural resources of the North-East Atlantic	https://odims.ospar .org/en/	REST API	TRUE	TRUE			1	2	2	2	4	2.05
96	CBS Statline (population data Netherlands)	https://opendata.c bs.nl/statline/porta .html?_la=nl&_catal og=CBS	OData API I	TRUE		TRUE		1	2	2	1	5	2.05
99	EIDA (European Integrated Data Archive)	<u>https://orfeus-</u> eu.org/data/eida/	https://orfeus- eu.org/data/eida/ webservices/	TRUE	TRUE			1	1	1	4	5	2.05
81	MagIC - Magnetics Information Consortium	https://www2.eart href.org/MagIC/sea rch	<u>a</u>	TRUE	TRUE			1	1	2	2	5	1.95
67	OpenEO Platform	https://stacindex.or g/catalogs/openeo- platform#/	STAC		TRUE			1	2	3		3	1.8
70	DG for agriculture and rural environment	<u>https://agriculture.</u> ec.europa.eu/data- and-analysis_en	Web API ?	TRUE		TRUE		1	2	2	2	2	1.75
97	4TU.RESEARCHDATA	https://data.4tu.nl/ category	OAI-PMH, NetCDF, OpenDAP					1	1	1	1	4	1.45



Appendix C. Reference Use Cases and Initiatives – Useful links

In this appendix, additional – to the ones provided in Section 3 – links related to the five Reference Use Cases and Initiatives of Phase 1 are provided.

Table 10: Useful links for the five Reference Use Cases and Initiatives of Phase 1

Reference Use	Useful Links					
Case						
Hydrology Use	GitHub UU-Hydro/PCR-GLOBWB_model: <u>https://github.com/UU-</u>					
Cases (Large-Scale	Hydro/PCR-GLOBWB model					
Hydrology and Seasonal Forecasting	PCRGLOBWB: https://geo.data.uu.nl/research-pcrglobwb/pcr-					
of Water Resources)	globwb gmd paper sutanudjaja et al 2018/					
,	4TU Research Data Catalogue:					
	https://opendap.4tu.nl/thredds/catalog/data2/pcrglobwb/catalog.html					
Global Observation	Data catalog: <u>https://sdi.iia.cnr.it/gos4mcat</u>					
System for Mercury (GOS4M)	GEO Portal Community: <u>https://www.geoportal.org/community/gos4m</u>					
	GEO Knowledge Hub:					
	https://gkhub.earthobservations.org/search?q=GOS4M					
European Marine	EMODnet central map viewer: <u>https://emodnet.ec.europa.eu/geoviewer/</u>					
Observation and Data Network	EMODnet central searchable metadata catalogue:					
(EMODNET)	https://emodnet.ec.europa.eu/geonetwork/srv/eng/catalog.search#/home_					
	EMODnet ERDDAP server providing data query (sub-setting) and					
	download functionality for gridded data sets. These functions are available					
	https://erddap.emodnet.eu/erddap/index.html					
	EMODnet web services documentation, with R tutorials and links to					
	Github:					
	nttps://emodnet.ec.europa.eu/en/emodnet-web-service-documentation					
	EMODnet tools and guidelines: <u>https://emodnet.ec.europa.eu/en/tools-</u>					
	guidelines					
	EMODnet use cases: <u>https://emodnet.ec.europa.eu/en/use-cases</u>					
	EMODnet data and data product portfolio:					
	https://emodnet.ec.europa.eu/en/communication#data-and-product					



European Plate	EPOS Data Portal Open source: <u>https://epos-eu.github.io/epos-open-</u>
Observing System	source/
European Research	
Infrastructure	Specific Thematic portals available at this URL: <u>https://www.epos-</u>
Consortium (EPOS	eu.org/tcs
ERIC)	
BioGIS 360	-



Annex 1: Legal and Ethical Assessment Methodology

The Legal and Ethical Assessment Methodology provided by the Ethics Advisor of the GREAT project, serves as a comprehensive framework designed to systematically identify, evaluate, and address legal and ethical risks associated with a project's deliverables. Following a "by design" approach, this methodology is seamlessly integrated into the project's technical workflow, ensuring the consideration of legal and ethical aspects throughout the project's lifecycle. Its primary objectives encompass optimizing technical and business goals, ensuring compliance with relevant legal standards and ethical principles, and fostering ongoing competence-building within the research community involved.

Implemented in three key steps, the methodology begins with a preliminary meeting involving Work Package (WP) leaders, where the foundational literature and guiding legal and ethical principles are presented. The checklist analysis phase follows, employing a proactive "learning-by-doing" approach to identify potential gaps and risks across domains such as Data Privacy, Ownership, Licenses, Competition, Artificial Intelligence, and Social Media. Feedback from the Ethics Advisor on identified gaps and risks is integrated into the final deliverable, concurrently nurturing the skills necessary for crafting resilient legal and ethical solutions. These solutions address a breadth of domains and prioritize the overall impact of the deliverable while aligning with research and business goals, fostering a comprehensive legal and ethical framework.