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Mapping ESRS Disclosure Datapoints to Relevant Datasets

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Mapping ESRS Disclosure Datapoints to Relevant Datasets

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Abstract: The integration of geospatial data into sustainability reporting frameworks addresses challenges related to inconsistent and outdated Environmental, Social, and Governance (ESG) information. This third white paper from the Financial Regulation Innovation Laboratory (FRIL) explores the application of geospatial data in enhancing the European Sustainability Reporting Standards (ESRS). By aligning geospatial datasets with specific ESRS disclosure requirements, the study provides a foundation for corporations conducting double materiality assessments, auditors validating disclosures, and third parties—such as financial institutions and environmental organisations—performing due diligence.

Geospatial data can be applied at the asset level (e.g., factories) or aggregated using a bottom-up approach linked to financial ownership, improving transparency and comparability across companies, sectors, and regions. However, the study finds that only 7% of ESRS datapoints can be externally validated due to the dependence on proprietary company information. Despite this limitation, different stakeholders benefit from distinct datapoints: investors may prioritise datapoints linked to external risks such as flooding or greenhouse gas emissions, while water-focused non-governmental organisations may emphasise hydrological indicators.

The EU Omnibus package (February 2025) introduces significant changes to ESRS and corporate sustainability reporting. These include a reduction in in-scope companies (80% fewer under the Corporate Sustainability Reporting Directive), limited value chain coverage, and fewer required datapoints, which may lead to a data gap and reduced transparency. However, the shift towards quantitative over qualitative datapoints presents a critical opportunity for geospatial data to bridge this gap, offering independent, real-time, and scalable insights for ESG reporting.

Furthermore, the revision of assurance requirements under the Omnibus package raises concerns about data verification and reporting accuracy. Given these regulatory shifts, integrating satellite-derived data into sustainability reporting frameworks could enhance objectivity, comparability, and reliability. Future regulations should embed geospatial data as a core element to strengthen the integrity and effectiveness of sustainability disclosures in the EU and beyond.

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1. Introduction

The World Bank and WWF highlighted that inconsistent ESG data has hindered the move to sustainable finance and suggested a geospatial approach as a solution to analyse companies independently without reliance on voluntary reporting frameworks (WWF, 2022). The World Bank also found issues with coverage and frequency, the 'data gap', of their sovereign ESG indicators, highlighting only 41 indicators (out of 127) had a datapoint less than 1 year old for at least 50% of the countries assessed; rendering them sub-optimal for any financial assessment (World Bank, 2020). Similarly, The Taskforce for Nature Related Disclosures (TNFD) have identified concerns around accessibility, quality, comparability, verifiability and assurance of the data required for corporate reporting, target setting and transition planning in the context of nature. They have proposed to build and test an open access Nature Data Public Facility (NDPF).

At the same time, the term ESG is being seen as polarising in corporate finance, with some arguing that it is a method for asset managers to pursue their own agenda, while others argue that it is aligned with increased financial and social returns (Edmans, 2024). Ultimately Edmans argues that ESG is important as it is critical to long-term value creation and therefore should be of interest to everyone. His proposal is a framework of rational sustainability, where sustainability is a core part of the business, like governance and culture, and should be driven by an evidence-based approach.

With the introduction of mandatory disclosures, underpinned by the European Sustainability Reporting Standards (ESRS) and introduced in previous white papers in this series:

- The EU Green Deal and Sustainable Finance Framework (https://doi.org/10.17868/strath.00092210), and
- The European Sustainability Reporting Standards and Opportunities for Financial Services (https://doi.org/10.17868/strath.00092211)

there is an opportunity to create the evidence suggested by Edmans linked with long-term value creation. Similarly, the ESRS has an opportunity to improve the data gap using geospatial data mapped to specific disclosure datapoints, allowing a fair and transparent comparison across companies, sectors, countries and geographical regions. This is pertinent with the introduction of double materiality. In this white paper, we now turn to practical implementation strategies.

A key aspect of operationalising sustainability disclosures—particularly for environmental matters like climate change, biodiversity, water, and pollution—is the ability to pinpoint where impacts occur, understand their intensity, and monitor changes over time. Geospatial data, including satellite imagery and location-based datasets, offers a powerful means of achieving this. By integrating geospatial data into double materiality assessments, both companies and Financial Services institutions can move beyond static, annual snapshots and instead gain near-real-time insight into evolving environmental risks, opportunities, and performance against sustainability targets.

This paper outlines how geospatial data supports the implementation of the ESRS by mapping different datasets to disclosure requirements, and specific datapoints.

2. Geospatial Data: A Foundation for Location-Based Insights

Geospatial data provides critical information about where a company's assets and upstream/downstream value chain operate and how those operations interact with the environment. By integrating **asset** location data (vector) with **observational** data (primarily raster), organisations can trace the impacts and dependencies within their value chains at a granular, site-specific level. Identifying potential **risks and opportunities,** as part of financial materiality, will also require **modelled data**, which is likely derived from observational data. This approach is essential for performing double materiality assessments, which require assessing both financial and impact materiality across global operations.

In geospatial analysis, two primary data types are commonly used:

- **Raster**: Raster data represents the Earth's surface as a grid of cells or pixels, where each cell has a specific value corresponding to a geographic attribute, such as temperature, elevation, or land cover. This format is particularly suited for continuous data and remote sensing imagery and can also be referred to as observational data.
- **Vector**: Vector data represents geographic features using points, lines, and polygons. It is ideal for discrete features like roads, boundaries, and landmarks, with attributes stored in associated tables. I

These data types are shown in the Figure 1. In certain cases, observational data will also be vector e.g. polygons that define the World Database of Protected Areas (WDPA), Key Biodiversity Areas (KBAs) and The International Union for Conservation of Nature (IUCN) Red List of Species.

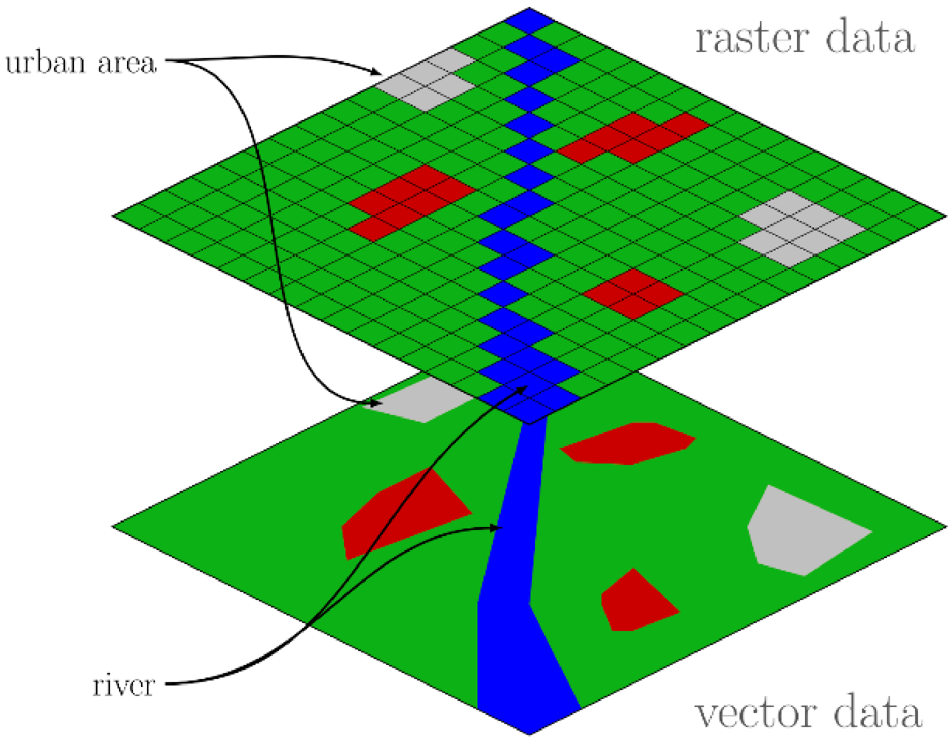

Figure 1 Comparison of raster and vector data. Image credit: Wegmann, CC BY-SA 3.0

Generally, raster data is available in abundance from many different sources. As an example, the Google Earth Engine platform (Google Earth Engine, 2025) has petabytes of data from hundreds of different datasets and providers. This is updated and expanded daily. This expansion is primarily due to satellites that collect and downlink data daily.

In the context of regulations, and specifically double materiality assessments, vector data is the most important as it defines the location of the direct operations and upstream / downstream value chain. Generally, it is also the hardest to source. One reason is due to data sensitivity. Companies may not want to disclose supply chain information for fear of negatively impacting their competitive advantage, reputational risk or disclosure risk. Similarly, downstream / upstream suppliers may be reluctant to provide this information due to their own privacy concerns. Asset location data availability is also affected by the industry sector, with higher impact (environmentally, primarily climate-related) having had more attention, meaning an open-source attempt to geolocate their supply chains. This is demonstrated in the fact data is available open source and commercially for sectors including oil and gas, mining, fishing, shipping, cement, steel and the power sector (WWF, 2024).

2.1 Data Resolution and Double Materiality

Geospatial data, specifically raster data, has four resolution attributes that should be considered when deciding if a dataset is usable for a double materiality assessment. These are radiometric, spatial, temporal and spectral resolution. In this section we explain the basics to provide the reader with the informed knowledge to understand data requirements in the context of double materiality assessments.

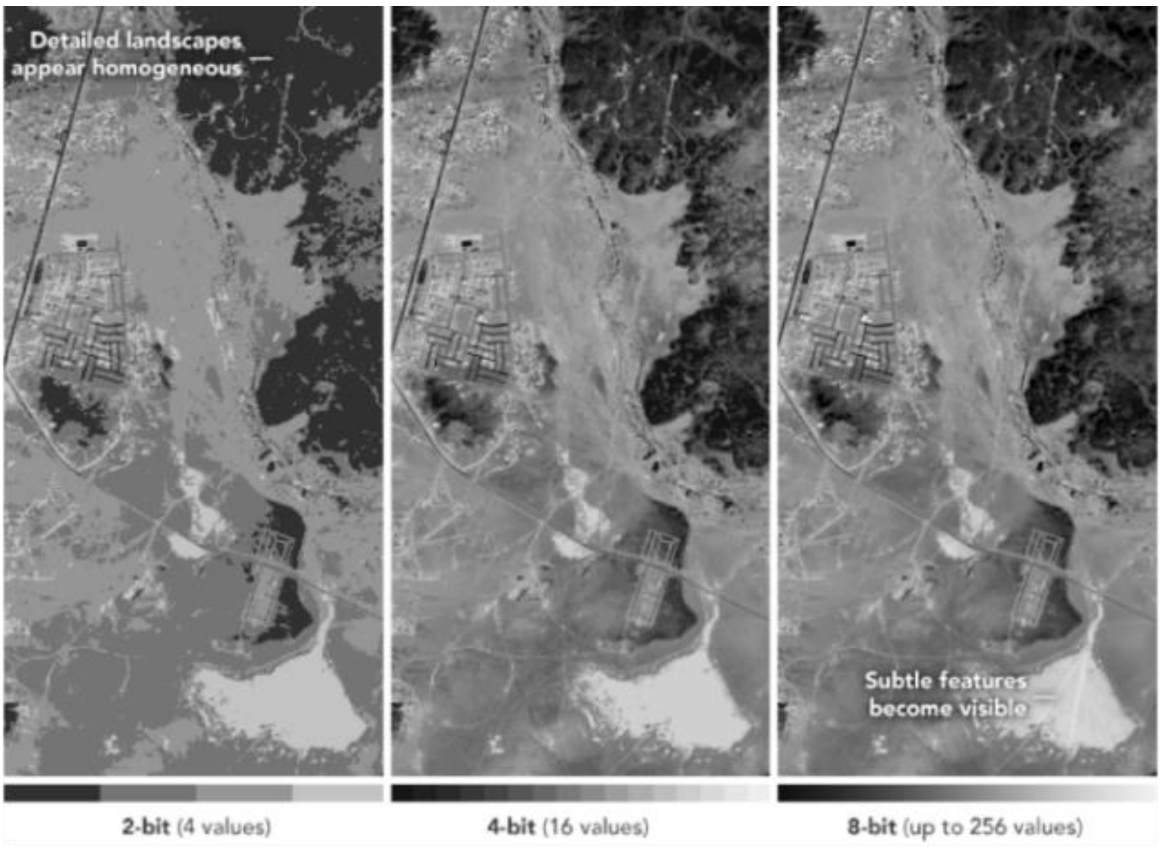

Figure 2 Radiometric resolution example. Image Credit: NASA Earth Observatory images by Joshua Stevens, using Landsat data from the U.S. Geological Survey

Radiometric resolution is simply the amount of data that can be stored in each pixel, which is ultimately a measure of the energy recorded. A higher radiometric resolution will allow for finer details to be discriminated within the image, as is shown in Figure 2, where the same image is shown for different radiometric resolutions, increasing from left to right. Note that subtle features become visible within the image on the right.

Figure 3 Spatial resolution example. Image Credit: NASA Earth Observatory

Spatial resolution is the size of each pixel and is demonstrated in Figure 3. The image shows the variation from 30 metres per pixel to 300 metres per pixel. As a rough guide, imagery at a resolution of 10 meters per pixel or less, is usually provided by a commercial company, and therefore will require a paid for commercial license. However, there are a variety of different data sources that are freely available to use commercially, providing resolution up to 10 metres per pixel.

Temporal resolution, also known as revisit rate, is the measure of how much time is needed to revisit and gather data from the exact same location on the planet. A higher temporal resolution will result in more images of a location. When considering satellites, the orbit around the Earth will dictate the temporal resolution. In the context of a double materiality assessment, the temporal resolution required is dictated by the measurement you are trying to make.

Spectral resolution refers to a sensor's ability to detect finer parts of the electromagnetic spectrum, as shown in Figure 4. Most sensors are referred to as multi or hyperspectral, meaning they sample different parts of the spectrum. The parts of the spectrum they sample are referred to as bands. A multispectral sensor, such as Sentinel 2 (funded by the EU with data freely available) has 13 spectral bands - meaning it takes 13 samples from different parts of the spectrum. A hyperspectral instrument may have hundreds or even thousands of spectral bands. The difference between a multispectral and hyperspectral band is its width. A smaller bandwidth provides finer spectral resolution and allows for greater distinction between features in the data. For example, different vegetation types have different spectral signatures. With a larger bandwidth, they may be considered 'woodland', but a smaller bandwidth may allow for species identification.

This is important when you consider biodiversity for example.

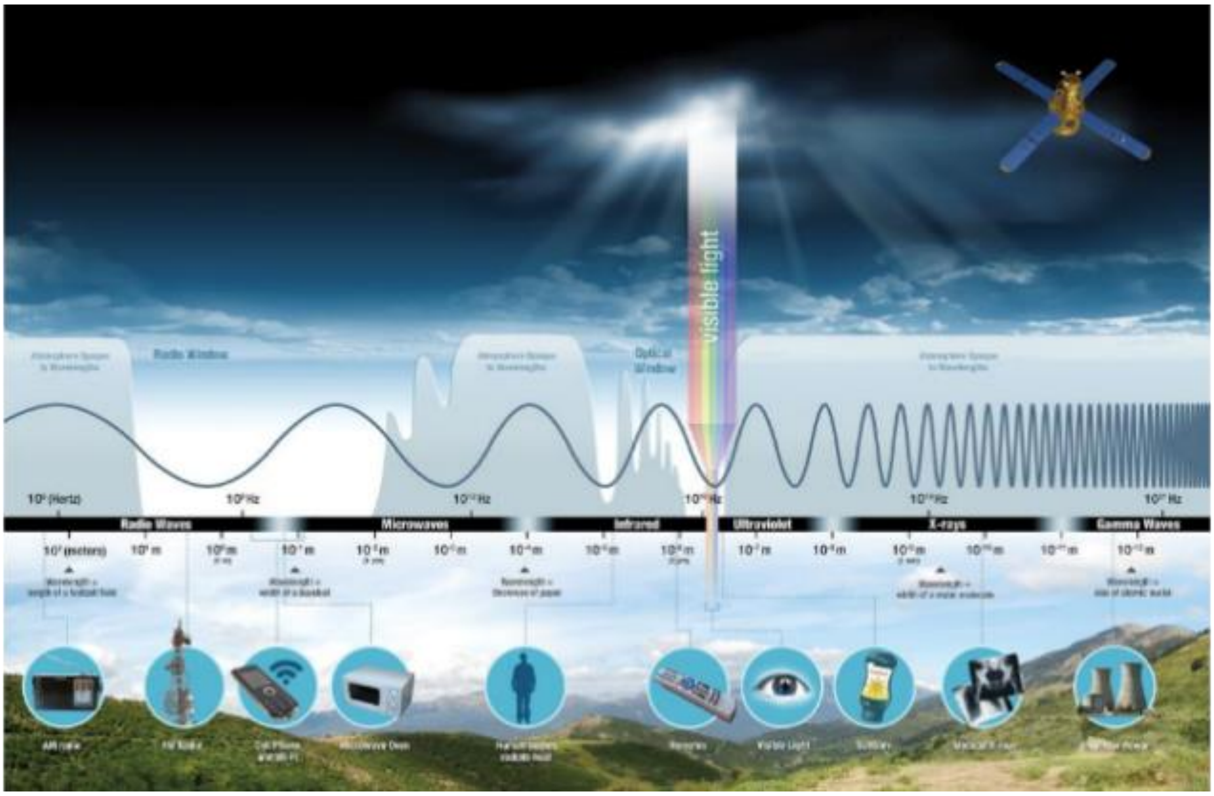

Figure 4 *Electromagnetic spectrum. Image Credit: NASA Earth Observatory*

2.2 Data considerations for double materiality assessments

Data products can be based on the raw sensor data, processed to facilitate ease-of-use (such as georectification to map data onto a standard map so that things are where we expect them to be) or aggregated to create a derivative dataset, which may include applying a processing algorithm to multiple raw data products. Selecting the correct data product for double materiality assessments is critical to ensure a suitable measurement without excessive cost.

For example, if you are trying to measure *Datapoint E1-6_07: Gross Scope 1 greenhouse gas emissions*, then you will require a **high temporal resolution**, likely daily, to capture the flux of emissions from an asset. To measure *Datapoint E4-5_02:* Area *of sites owned, leased or managed in or near protected areas of key biodiversity areas that undertaking is negatively affecting* then you will require **high spatial resolution** to accurately measure the areas of sites owned in or near critical areas. Furthermore, if you are trying to measure *Datapoint E4-5_05: Disclosure of conversion over time of land cover,* then you will likely require **high spatial, radiometric and spectral resolution** (higher spatial and radiometric resolution will help to more accurately detect boundaries between different habitats) and higher spectral resolution will better discriminate between habitat types that have different spectral signatures.

Every sensor design requires careful trade-offs between the different factors and the goal of the sensor. For example, a single instrument cannot have high spatial, spectral and temporal resolution - a higher spatial resolution requires a smaller swath (the projected footprint the sensor has on the ground), which results in a higher temporal frequency. Constellations of satellites reduce this problem but require more capital due to associated production and launch costs.

Combinations of different sensor bands can offer different insights for specific applications. To see what a human sees, you can combine the red, green and blue bands to provide RGB true colour. Vegetation health can be measured with a normalised difference vegetation index (NDVI), which uses both the red and near infra-red bands and water can be detected using both the green and near infrared or shortwave infrared bands, to create normalised and modified normalised difference water index respectively (NDWI & MNDWI). The modified index was developed to better discriminate between urban buildings and water. This is shown in Figure 5 using sentinel 2 imagery for the same area. Note that in the MNDWI there are some water bodies highlighted in grey that have not been detected as water, which could be due to multiple reasons such as these being manmade reservoirs but highlights an important point regarding the accuracy of geospatial data, which is discussed further in the next section. There are many ways to overcome these issues, such as using multiple datasets and cross validation, but one should be aware these issues exist when performing any analysis using derived data products.

Figure 5: (Left) True colour, (Centre) Normalised Difference Vegetation Index and (Right) Normalised Mean Difference Water Index from Sentinel

3. Near-Real-Time Monitoring and Decision-Making

Generally, the key advantage of geospatial data, specifically satellite data, lies in its frequency and global coverage, due to temporal resolution. Unlike traditional ESG data reliant on annual reports, satellites capture unbiased environmental changes regularly, often on a weekly or even daily basis e.g. forest fires/flooding. This allows both corporations and Financial Services firms to monitor progress towards sustainability targets, or assess investor risk, in near-real-time. Whether tracking deforestation around supply chain assets (ESRS E4) or changes in water stress levels near critical sites (ESRS E3), geospatial data can enable prompt evidence-based responses, risk mitigation, and continuous improvement.

For investors, this kind of ongoing monitoring allows for the evaluation of a company’s ability to follow through on sustainability commitments. If a firm has disclosed certain targets, policies, and actions in response to material sustainability issues - a requirement in the ESRS - geospatial monitoring may provide a mechanism to verify whether operations and their surroundings are changing as intended. This is pertinent as targets have been found to disappear after announcement due to likelihood of missed targets at expiration date (Jiang et al., 2025). Financial Services organisations can thus incorporate timely ESG data into credit risk models, insurance underwriting processes, and investment scoring systems, increasing the accuracy and relevance of their assessments.

The data required is driven by the end user requirements - e.g. a company disclosing their asset-specific material sustainable issues will require data at a resolution that allows them to assess the local environment to the asset - a spatial resolution of 1000 km will not fit this requirement. However, this may suit an investor interested in sovereign debt as this resolution may be suitable to compare countries directly. (WWF, 2022) discussed limitations, specifically referencing the open Biodiversity data (which is listed on the UN's Biodiversity Lab (UN Biodiversity Lab, n.d.), which is repeated here for clarity, along with commentary from the author of this paper to add Financial Services context:

1 Temporal consistency - referring to the lack of datapoints over a sustained period. (WWF 2022) analysed 105 data layers listed on the UN Biodiversity Lab and found that only 38% of datasets had data for more than one year. **Author commentary**: While this may be the case for datasets that require extensive research and validation, such as the biodiversity intactness index, satellite data provides updates at a frequency of days rather than years. The dataset complexity, like in the example of biodiversity, requires special research attention and therefore efforts should be made to create a system that can update specific indicators at more regular intervals. Other topics, such as water and emissions data, are updated more frequently.

2 Spatial resolution - referring to the fact that open-source datasets are often of lower resolution. Of the 105 data layers, 24 had a resolution below 100m. **Author commentary**: The importance of this depends on the datapoint. They cite the reason for this as being that datasets are primarily built from publicly available datasets created by NASA and ESA. However, commercial datasets are available at finer resolutions. The main challenge here is identifying these datasets and determining their value-add to the problem at hand. If there is a positive business case to commercially acquire data, then there will likely be willingness from Financial Services to procure that data.

3 Accuracy - referring to the accuracy of geospatial data not being absolute. **Author commentary**: Accuracy of different datasets can vary based on several factors such as instrument, atmosphere, processing algorithms and politics (Prior to the delay in 2024 of the EU's deforestation regulation (EUDR), nations were disputing the definition of forest with the EU, which could result in a detrimental impact to their EUDR linked commodity exports (Financial Times, 2024)). Data is becoming more accurate with the development of new technology and methodologies, and most datasets are created from peer-reviewed research and algorithms, meaning there is an inherent degree of accuracy. However, Financial Services data users should consider a convergence-of-evidence approach for geospatial data; where several datasets can be used together to ensure that, generally, they offer the same conclusion. This was demonstrated in the Sentinel 2 image where a water reservoir is not detected as water.

4 Data interdependencies - referring to the fact that several datasets rely on the same source of data, and therefore may contain the same underlying errors, if any. **Author commentary**: Financial Services data users should perform comprehensive due diligence of datasets prior to use.

5 Relevancy - referring to the fact that geospatial data does not always explicitly capture the exact metrics required. **Author commentary**: This is particularly relevant to this paper as we map relevant datasets to datapoints in proceeding sections.

6 Challenges of 'Biodiversity' - referring to the complexity of this specific topic in terms of measurement. **Author commentary**: The name suggests that there may be many measurements required, and this amplifies all the previous issues discussed for this specific topic, which is ESRS E4.

The primary takeaway is that geospatial data is not a silver bullet to solve all data challenges. However, it can be a critical part of the regulation process. It should not be considered in isolation, but instead as part of a wider approach, specific to each user's needs.

4. Data Mapping Methodology

To begin to map geospatial data to the relevant datapoints, the first step was to review each datapoint and to assess whether it is possible to use external data sources for its measurement. We assessed each datapoint from the perspective of an independent user with the aim of externally validating a disclosure made by a company i.e. an investor analyst or auditor. Upon determining if the datapoint could be measured with external data, we determined whether the external data source is geospatial or another format. Additionally, we determined whether the datapoint could be measured in full or by proxy. An underlying assumption was that the user already has, or can obtain, knowledge of value chain locations. This is not a trivial task, and is an active area of research, but several datasets do exist. Often, these are for high environmental impact sectors such as oil and gas, mining, fishing, shipping, cement, steel and the power sector (WWF, 2024). The extract from the data mapping methodology described is shown in Table 1.

ESRS ID	Datapoint	Data Type	Measure	Measurement Type	Context	Data source
E3-4_02	Total water consumption in areas at water risk, including areas of high-water stress	Geospatial	Volume (m^3)	Proxy	The risk atlas and risk filter can identify the areas of water risk and high-water stress, but cannot provide exact volumetric data of water consumption by the company	WRI Aqueduct - Water Risk Atlas WWF Water Risk Filter FAO AQUASTAT
E4-5_02	Area of sites owned, leased or managed in or near protected areas or key biodiversity areas that undertaking is negatively affecting	Geospatial	Number and Area (ha)	Full	Assuming we have ownership data, the area (ha) of sites near protected / biodiversity areas can be calculated	World Protected Areas Key Biodiversity Areas

Table 1 Dataset mapping extract showing geospatial datasets being mapped directly to ESRS datapoints and highlighting the difference between proxy and full measurement mappings.

Using the above methodology, 1,145 datapoints were assessed across all topics of the ESRS. It was determined that only 76 (7%) may be suitable for external validation. 70 may be validated with geospatial data while the remainder require non-geospatial data, such as the EU transparency register for political donations. 52 datapoints may be suitable for full validation with 24 being validated at the proxy level. This suggests that from an external assessment perspective, 1,069 datapoints (93%) require internal, proprietary data. It is evident that the number of datapoints that can be measured externally is low. However, the importance of each datapoint is not uniform. Users of the data, such as Financial Services, Non-Governmental Organisations or auditors may treat the material impact of each datapoint differently depending on their perspective - for example, a water-focussed NGO will likely place more emphasis on E3: Water and Marine Resources, whereas a Financial Services user may place more emphasis on carbon emissions (E1: Climate Change) due to their associated risk on capital markets. The data split described above can be broken down across the different standard topics as shown in Figure 5, which demonstrates a strong alignment between the environmental metrics and geospatial data.

The data mapping process resulted in a list of datasets that the reader can use as a starting point for their specific use case. The data map is provided in the Annex of this paper. Where appropriate, up to 4 datasets per datapoint are provided. There is also information about the coverage, temporal and spatial resolution.

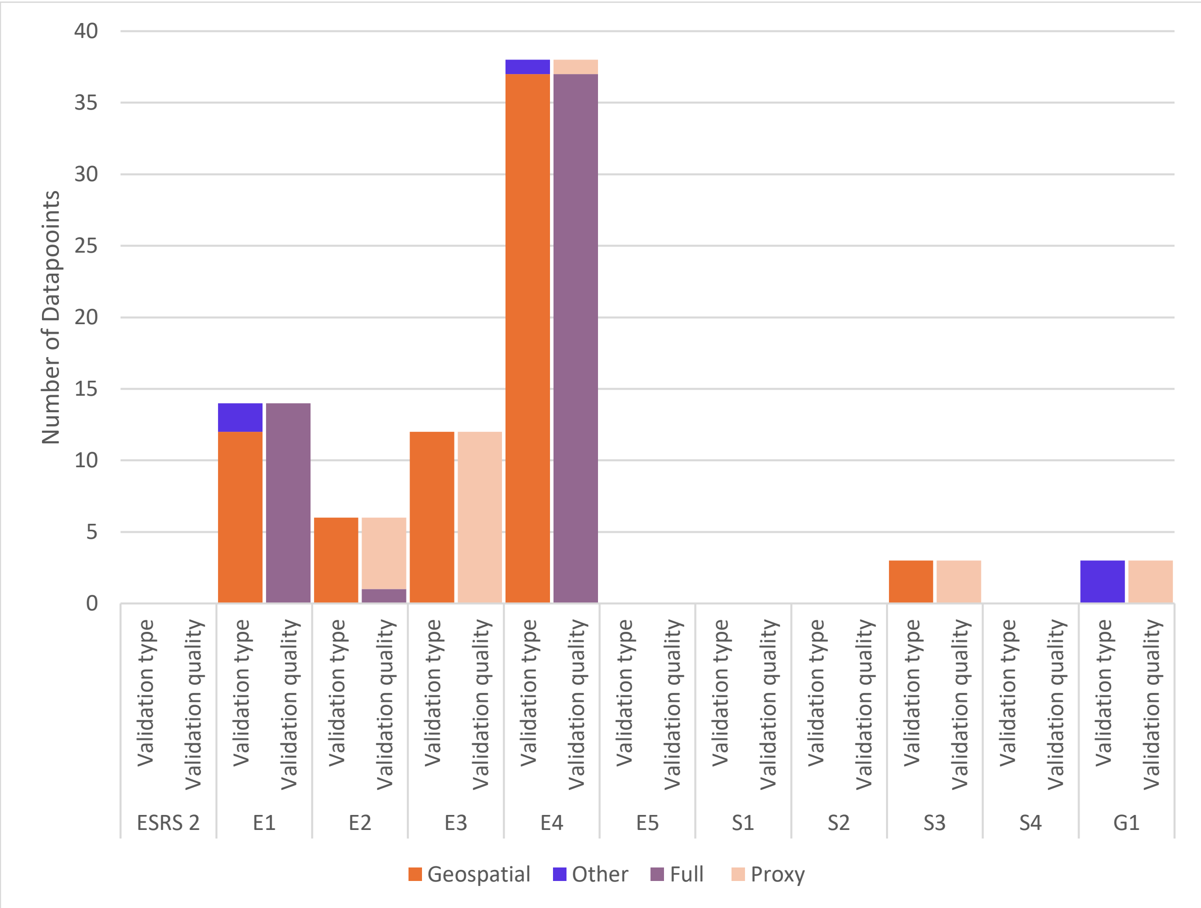

Figure 5 ESRS datapoints that are suitable for external validation, broken down by sustainability topic, external validation data source and whether the datapoint can be fully addressed with the external data source.

5. EU Omnibus

The EU Omnibus package, announced in February 2025, aims to reduce 'red tape' and simplify EU regulations for citizens and businesses (European Commission, 2025a). Among the proposed updates to the ESRS are reductions in the number of required datapoints, a greater emphasis on quantitative over qualitative metrics, clearer distinctions between mandatory and voluntary disclosures, and the removal of sector-specific datapoints. The package also enhances inter-operability with existing standards. Notably, from a Financial Services sector perspective, it introduces clearer guidance on the materiality principle to prevent assurance service providers from requesting unnecessary disclosures or requiring excessive resources for materiality assessments (European Commission, 2025b).

These changes present both opportunities and challenges for the Financial Services sector. The prioritisation of quantitative datapoints could enhance the role of geospatial data in validating sustainability metrics externally. Additionally, clearer materiality guidance may improve relationships between assurance providers and their clients. However, the removal of sector-specific standards and the overall reduction in datapoints will limit the depth of available data, potentially affecting risk assessments and investment decisions.

Moreover, when combined with the broader Omnibus changes to the Corporate Sustainability Reporting Directive (CSRD) and Corporate Sustainability Due Diligence Directive (CSDDD)—including an 80% reduction in in-scope companies, limited value chain coverage, restricted assurance requirements and increasement assessment periods—these revisions create a data gap and reduce overall data quality. This will make sustainability risk assessments and investment decision-making more challenging for Financial Services.

Although the package has yet to be formally adopted, geospatial data will play a crucial role in bridging this data gap and improving data quality for Financial Services, helping to mitigate the impact of reduced reporting requirements.

6. Conclusion

The Corporate Sustainability Reporting Directive (CSRD) significantly expands environmental, social, and governance (ESG) reporting requirements for companies operating within the EU, guided by the European Sustainability Reporting Standards (ESRS). A key component of these standards is the double materiality assessment, which requires companies to evaluate both financial materiality and impact materiality across their operations.

This paper examined the feasibility of externally validating ESRS datapoints using geospatial data, particularly satellite-derived information. The findings indicate that only 7% of the total datapoints can be externally validated due to the reliance on proprietary company data. However, despite this limitation, different stakeholders derive value from distinct datapoints. For instance, investors may prioritise metrics related to external environmental risks, while environmental organisations may focus on specific ecological indicators.

As the EU Omnibus package shifts reporting priorities towards quantitative datapoints, there is a timely opportunity to integrate satellite data as a foundational element in sustainability reporting. Doing so would enhance transparency, objectivity, and comparability in ESG disclosures. Future regulatory developments should actively incorporate these insights to strengthen the integrity and effectiveness of sustainability reporting within the EU and beyond.

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Annex 1 – ESRS datapoint - dataset map

Datapoint Name	Datapoint ID	Dataset Name	Coverage	Temporal Resolution	Spatial Resolution
Climate-related hazards have been identified over short-, medium- and long-term time horizons	E1.IRO-1_03	Copernicus Climate Data Store (C3S)	Global	Monthly / Annual	~30km
		IPCC AR6 Interactive Atlas	Global	Static (scenario-based)	~1°
		EEA Climate-ADAPT Datasets	Europe	Periodic	Regional / NUTS-level
Undertaking has screened whether assets and business activities may be exposed to climate-related hazards	E1.IRO-1_04	Geocoded Disasters (GDIS) Dataset	Global	Event-level (1960–2018)	Variable (~10-50 km)
		Copernicus Climate Data Store (C3S)	Global	Monthly / Annual	~25 km
		NOAA Climate Hazards / Indicators (NCEI)	Global	Monthly / After events	Variable (~25 km+)
Identification of climate-related hazards and assessment of exposure and sensitivity are informed by high emissions climate scenarios	E1.IRO-1_07	IPCC Climate Scenarios Data (CMIP6)	Global	Static (scenario-based)	~100 km
		IEA Climate Scenario Data	Global	Annual scenario-based	Regional / Country-level
		Copernicus C3S Climate Projections	Global	Periodic scenario releases	~25-50 km
Transition events have been identified over short-, medium- and long-term time horizons	E1.IRO-1_10	Projections from AOGCM Ensemble (Bioclimatic Variables)	Global	Scenario-based (~future periods)	~1-10 km
		IPCC AR6 Scenario Data	Global	Static (scenario-based)	~1°
		IEA Transition Scenario Data	Global	Annual scenario-based	Country / Regional-level
		NGFS Climate Scenarios	Global	Scenario-based	Country-level
Undertaking has screened whether assets and business activities may be	E1.IRO-1_11	Projections from AOGCM Ensemble (Bioclimatic Variables)	Global	Scenario-based (~future periods)	~1-10 km

exposed to transition events		IPCC AR6 Scenario Data	Global	Static (scenario-based)	~1°
		WRI Aqueduct Climate / Transition Risk Data	Global	Irregular updates	~50 km
		IEA Transition Scenario Data	Global	Annual scenario-based	Country / Regional-level
Extent to which assets and business activities may be exposed and are sensitive to identified transition events has been assessed	E1.IRO-1_12	IEA Transition Scenario Data	Global	Annual scenario-based	Country / Regional-level
		Copernicus Climate Data Store (C3S)	Global	Monthly / Annual	~25 km
		IPCC AR6 Scenario Data	Global	Static (scenario-based)	~1°
Identification of transition events and assessment of exposure has been informed by climate-related scenario analysis	E1.IRO-1_13	Projections from AOGCM Ensemble (Bioclimatic Variables)	Global	Scenario-based (~future periods)	~1-10 km
		IPCC AR6 Scenario Data	Global	Static (scenario-based)	~1°
		CMIP6 Climate Scenarios	Global	Periodic scenario releases	~100 km
		NGFS Climate Scenarios	Global	Scenario-based	Country-level
Achieved GHG emission reductions	E1-3_03	Climate Trace Emissions	Global	Monthly	asset level
		EDGAR (Emissions Database for Global Atmospheric Research)	Global	Annual	~10 km
		MethaneSAT (oil and gas specific)	Global	Weekly	Asset level
		GHGSat	Global	Weekly	Asset level
		Carbon Mapper	Global	Weekly	Asset level
Expected GHG emission reductions	E1-3_04	Climate Trace Emissions	Global	Monthly	asset level
		EDGAR (Emissions Database for Global Atmospheric Research)	Global	Annual	~10 km

		MethaneSAT (oil and gas specific)	Global	Weekly	Asset level
		GHGSat	Global	Weekly	Asset level
		Carbon Mapper	Global	Weekly	Asset level
Percentage of Scope 1 Greenhouse gas emissions reduction (as of emissions of base year)	E1-4_07	Climate Trace Emissions	Global	Monthly	asset level
		EDGAR (Emissions Database for Global Atmospheric Research)	Global	Annual	~10 km
		MethaneSAT (oil and gas specific)	Global	Weekly	Asset level
		GHGSat	Global	Weekly	Asset level
		Carbon Mapper	Global	Weekly	Asset level
Intensity value of Scope 1 Greenhouse gas emissions reduction	E1-4_08	Climate Trace Emissions	Global	Monthly	asset level
		EDGAR (Emissions Database for Global Atmospheric Research)	Global	Annual	~10 km
		MethaneSAT (oil and gas specific)	Global	Weekly	Asset level
		GHGSat	Global	Weekly	Asset level
		Carbon Mapper	Global	Weekly	Asset level
GHG emission reduction target is science based and compatible with limiting global warming to one and half degrees Celsius	E1-4_22	IPCC SR1.5 Scenario Data	Global	Static (scenario-based)	~1°
		IEA Net-Zero by 2050 Scenario Data	Global	Annual scenario-based	Country / Regional-level
		NGFS 1.5°C Pathways	Global	Scenario-based	Country-level
Diverse range of climate scenarios have been considered to detect relevant environmental, societal, technology, market and policy-related developments and determine decarbonisation levers	E1-4_24	IEA World Energy Outlook (for scenario insights)	Global	Annual scenario-based	Country / Regional-level
		IPCC AR6 Scenario Data	Global	Static scenario-based	~1°
		WRI Climate Scenario Explorer	Global	Irregular scenario-based	Country-level
Gross Scope 1 greenhouse gas emissions	E1-6_07	Climate Trace Emissions	Global	Monthly	asset level
		EDGAR (Emissions Database for Global	Global	Annual	~10 km

		Atmospheric Research)			
		MethaneSAT (oil and gas specific)	Global	Weekly	Asset level
		GHGSat	Global	Weekly	Asset level
		Carbon Mapper	Global	Weekly	Asset level
Pollution of air, water and soil [multiple dimensions: at site level or by type of source, by sector or by geographical area	E2-4_01	Climate Trace Emissions	Global	Monthly	asset level
		EDGAR (Emissions Database for Global Atmospheric Research)	Global	Annual	~10 km
		MethaneSAT (oil and gas specific)	Global	Weekly	Asset level
		GHGSat	Global	Weekly	Asset level
		Carbon Mapper	Global	Weekly	Asset level
		UN Environment GEMS / Water Database (for water pollution)	Global	Periodic	Basin-level
		Copernicus Atmosphere Monitoring Service (for air pollution)	Global	Daily / Monthly	~10 km
Emissions to air by pollutant	E2-4_02	Climate Trace Emissions	Global	Monthly	asset level
		EDGAR (Emissions Database for Global Atmospheric Research)	Global	Annual	~10 km
		MethaneSAT (oil and gas specific)	Global	Weekly	Asset level
		GHGSat	Global	Weekly	Asset level
		Carbon Mapper	Global	Weekly	Asset level
Emissions to water by pollutant [+ by sectors / Geographical Area / Type of source / Site location]	E2-4_03				
		EEA Waterbase	Europe	Annual	River-basin-level
		UN Environment GEMS / Water	Global	Periodic	Basin-level
Description of changes over time (pollution of air, water and soil)	E2-4_08	DynQual v1 Global Surface Water Quality	Global	Monthly / Annual	~0.1°
		E-PRTR (Temporal Change Data)	Europe	Annual	Facility-level (~1-10 km)

		UN Environment GEMS / Water (time series)	Global	Periodic	Basin-level
		Copernicus Atmosphere Data (Trends in Air Quality)	Global	Monthly / Annual	~10 km
Percentage of total emissions of pollutants to water occurring in areas at water risk	E2-4_11	WRI Aqueduct Water Risk Atlas	Global	Periodic	~50 km
		WWF Water Risk Filter	Global	Periodic	Basin-level (~10-50 km)
		FAO AQUASTAT	Global	Annual	Country-level
Percentage of total emissions of pollutants to water occurring in areas of high-water stress	E2-4_12	WRI Aqueduct Water Risk Atlas	Global	Periodic	~50 km
		WWF Water Risk Filter	Global	Periodic	Basin-level (~10-50 km)
		FAO AQUASTAT	Global	Annual	Country-level
Percentage of total emissions of pollutants to soil occurring in areas of high-water stress	E2-4_14	WRI Aqueduct Water Risk Atlas	Global	Periodic	~50 km
		WWF Water Risk Filter	Global	Periodic	Basin-level (~10-50 km)
		FAO AQUASTAT	Global	Annual	Country-level
The policy avoid impacts on affected communities.	E3-1_12	IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
		WRI Aqueduct Water Risk Atlas	Global	Periodic	~50 km
		WWF Water Risk Filter	Global	Periodic	Basin-level (~10-50 km)
		GBIF (Occurrence data for species proxy for community impacts)	Global	Continuous updates	Point-level
(Local) ecological threshold and entity-specific allocation were taken into	E3-3_04	IEA / FAO Water Resources Scenarios (Proxy for thresholds)	Global	Annual or scenario-based	Country-level

consideration when setting water and marine resources target		WRI Aqueduct (Baseline data)	Global	Periodic	~50 km
		WWF Water Risk Filter	Global	Periodic	Basin-level (~10-50 km)
Total water consumption	E3-4_01	FAO AQUASTAT (Water Consumption)	Global	Annual	Country-level
		WRI Aqueduct Water Use	Global	Periodic	~50 km
		EEA Water Accounts (Europe only)	Europe	Annual	River-basin-level
Total water consumption in areas at water risk, including areas of high-water stress	E3-4_02	WRI Aqueduct Water Risk Atlas	Global	Periodic	~50 km
		FAO AQUASTAT	Global	Annual	Country-level
		WWF Water Risk Filter	Global	Periodic	Basin-level (~10-50 km)
Total water stored	E3-4_04	FAO AQUASTAT (Water Storage)	Global	Annual	Country-level
		EEA Water Accounts (Europe)	Europe	Annual	River-basin-level
		GRanD Database (Global Reservoir and Dam Database)	Global	Static	Reservoir-level (~1km)
Changes in water storage	E3-4_05	FAO AQUASTAT (Change in storage as derived)	Global	Annual	Country-level
		GRanD Database	Global	Static	Reservoir-level (~1km)
		WRI Aqueduct	Global	Periodic	~50 km
Water intensity ratio	E3-4_08	WRI Aqueduct (Water Intensity Proxy)	Global	Periodic	~50 km
		FAO AQUASTAT (Derived intensity metrics)	Global	Annual	Country-level
		EEA Water Efficiency Indicators (Europe)	Europe	Periodic	Regional-level
Water consumption - sectors / SEGMENTS [table]	E3-4_09	FAO AQUASTAT (Sectoral water consumption)	Global	Annual	Country-level
		WRI Aqueduct	Global	Periodic	~50 km
		EEA Water Accounts	Europe	Annual	River-basin-level

Additional water intensity ratio	E3-4_10	FAO AQUASTAT (Derived intensity ratios)	Global	Annual	Country-level
		WRI Aqueduct	Global	Periodic	~50 km
		EEA Water Indicators	Europe	Periodic	Regional-level
Total water withdrawals	E3-4_11	FAO AQUASTAT (Water Withdrawals)	Global	Annual	Country-level
		WRI Aqueduct	Global	Periodic	~50 km
		EEA Waterbase	Europe	Annual	River-basin-level
Total water discharges	E3-4_12	FAO AQUASTAT (Water Discharges as proxy)	Global	Annual	Country-level
		WRI Aqueduct	Global	Periodic	~50 km
		EEA Waterbase	Europe	Annual	River-basin-level
Description of related products and services at risk (water and marine resources)	E3-5_05	WWF Water Risk Filter (Identification of products at water risk)	Global	Periodic	Basin-level (~10-50 km)
		WRI Aqueduct (Industry-specific water stress)	Global	Periodic	~50 km
		FAO AQUASTAT (Contextual info)	Global	Annual	Country-level
List of material sites in own operation	E4.SBM-3_01	Open Supply Hub	Global	Regular	asset level
		Global Legal Entity Identifier Foundation (used alongside geo data, such as Open Supply Hub)	Global	Regular updates	N / A
		OpenStreetMap	Global	Continuous updates	asset level
Disclosure of activities negatively affecting biodiversity sensitive areas	E4.SBM-3_02	IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
		NATURA 2000 (EU protected areas)	Europe	Periodic	Site-level (~1km)
Disclosure of list of material sites in own	E4.SBM-3_03	IBAT : Integrated Biodiversity	Global	Periodic	Site-level (~1km)

operations based on results of identification and assessment of actual and potential impacts on biodiversity and ecosystems		Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)			
		World Database of Protected Areas WDPA	Global	Periodic	Site-level (~1km)
		NATURA 2000 (EU)	Europe	Periodic	Site-level (~1km)
Disclosure of biodiversity-sensitive areas impacted	E4.SBM-3_04	IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
		GBIF (occurrence data for species proxy)	Global	Continuous	Point-level
		Copernicus Land Cover (land use impacts)	Europe	3-6 years	100m
Disclosure of whether and how actual and potential impacts on biodiversity and ecosystems at own site locations and in value chain have been identified and assessed	E4.IRO-1_01	Biodiversity Intactness Index (BII)	Global	Periodic updates	~1-10 km
		GBIF (occurrence data for species proxy)	Global	Continuous	Point-level
		IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
Disclosure of whether and how dependencies on biodiversity and ecosystems and their services have been identified and assessed at own site locations and in value chain	E4.IRO-1_02	Biodiversity Intactness Index (BII)	Global	Periodic updates	~1-10 km
		GBIF (occurrence data for species proxy)	Global	Continuous	Point-level
		IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and	Global	Periodic	Site-level (~1km)

		the IUCN Threatened Species List)			
Disclosure of whether and how transition and physical risks and opportunities related to biodiversity and ecosystems have been identified and assessed	E4.IRO-1_03	IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
Disclosure of whether and how systemic risks have been considered (biodiversity and ecosystems)	E4.IRO-1_04	IPBES (Systemic risks)	Global	Irregular	~10-50 km
		IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
Disclosure of the geographical scope of the targets	E4-4_07	IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
		Corine Land Cover (For EU targets)	Europe	3-6 years	100m
Disclosure of metrics considered relevant (land-use change, freshwater-use change and (or) sea-use change)	E4-5_04	Copernicus Land Monitoring Service (Land use metrics)	Europe	3-6 years	100m
		Dynamic World	Global	3-5 days	10m
Disclosure of conversion over time of land cover	E4-5_05	Corine Land Cover (Land cover conversion)	Europe	3-6 years	100m
		Dynamic World	Global	3-5 days	10m
Disclosure of changes in spatial configuration of landscape	E4-5_07	Dynamic World	Global	3-5 days	10m
		Corine Land Cover (spatial patterns)	Europe	3-6 years	100m
Disclosure of changes in ecosystem structural connectivity	E4-5_08	Connectivity indices from Copernicus Biodiversity projects	Europe	Irregular	~100m-1km

		IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
Disclosure of functional connectivity	E4-5_09	IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
		GBIF occurrence data	Global	Continuous	Point-level
		NATURA 2000	Europe	Periodic	Site-level (~1km)
Disclosure of metrics considered relevant (state of species)	E4-5_17	IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
		GBIF occurrence trends	Global	Continuous	Point-level
Disclosure of population size, range within specific ecosystems and extinction risk	E4-5_19	IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
		GBIF species occurrences	Global	Continuous	Point-level
Disclosure of changes in number of individuals of species within specific area	E4-5_20	GBIF (Changes in number of individuals proxy)	Global	Continuous	Point-level
		IBAT : Integrated Biodiversity	Global	Periodic	Site-level (~1km)

		Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)			
Information about species at global extinction risk	E4-5_21	IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
		GBIF occurrences (trend analysis)	Global	Continuous	Point-level
Disclosure of threat status of species and how activities or pressures may affect threat status	E4-5_22	IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
Disclosure of change in relevant habitat for threatened species as proxy for impact on local population extinction risk	E4-5_23	IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
		Corine Land Cover (if EU-based)	Europe	3-6 years	100m
		Dynamic World	Global	3-5 days	10m
Disclosure of ecosystem area coverage	E4-5_24	Corine Land Cover (Ecosystem area)	Europe	3-6 years	100m
		Dynamic World	Global	3-5 days	10m
Disclosure of quality of ecosystems relative to predetermined reference state	E4-5_25	Reference state via Ecosystem Condition Typologies (e.g.MAES in Europe)	Europe	Irregular	~100m
		Copernicus Ecosystem Service Layers	Europe	Periodic	~100m

		IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
Disclosure of multiple species within ecosystem	E4-5_26	GBIF (Multiple species occurrences)	Global	Continuous	Point-level
		IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
Disclosure of structural components of ecosystem condition	E4-5_27	Copernicus Ecosystem Monitoring	Europe	3-6 years	~100m
		IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
Description of related products and services at risk (biodiversity and ecosystems) over the short-, medium- and long-term	E4-6_05	IPBES Assessments (Risk to products / services)	Global	Periodic	Varies (~1-10 km)
		WWF Biodiversity Risk Filter	Global	Periodic	~10-50 km
		IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
Material negative impacts with regards to land degradation,	E4.SBM-3_05	FAO Land Degradation Assessments	Global	Irregular	Country / Regional-level

desertification of soil sealing have been identified		Copernicus Land Monitoring (Soil sealing)	Europe	3-6 years	100m
		Dynamic World	Global	3-5 days	10m
Own operations affect threatened species	E4.SBM-3_06	IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
		GBIF (Species occurrences near sites)	Global	Continuous	Point-level
Undertaking has sites located in or near biodiversity-sensitive areas	E4.IRO-1_14	IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
Activities related to sites located in or near biodiversity-sensitive areas negatively affect these areas by leading to deterioration of natural habitats and habitats of species and to disturbance of species for which protected area has been designated	E4.IRO-1_15	IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
		GBIF (Species occurrences near sites)	Global	Continuous	Point-level
Target is informed by relevant aspect of EU Biodiversity Strategy for 2030	E4-4_05	EU Biodiversity Strategy official datasets (via EEA)	Europe	Periodic	Regional / National-level
		IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)

Number of sites owned, leased or managed in or near protected areas or key biodiversity areas that undertaking is negatively affecting	E4-5_01	IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
		Open Supply Hub	Global	Regular	asset level
		Global Legal Entity Identifier Foundation (used alongside geo data, such as Open Supply Hub)	Global	Regular updates	N / A
Number of invasive alien species	E4-5_15	IUCN Global Invasive Species Database	Global	Periodic updates	Varies (~1-10 km)
		GBIF (records of invasive species)	Global	Continuous	Point-level
		European and Mediterranean Plant Protection Organization (EPPO) Database	Global	Irregular	Country / Regional-level
Area of sites owned, leased or managed in or near protected areas or key biodiversity areas that undertaking is negatively affecting	E4-5_02	IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
		Corine Land Cover (for EU owned sites)	Europe	3-6 years	100m
		Dynamic World	Global	3-5 days	10m
		Open Supply Hub	Global	Regular	asset level
		Global Legal Entity Identifier Foundation (used alongside geo data, such as Open Supply Hub)	Global	Regular updates	N / A
Total use of land area	E4-5_10	Corine Land Cover (Total land area)	Europe	3-6 years	100m
		Dynamic World	Global	3-5 days	10m
Total sealed area	E4-5_11	Corine Land Cover (Sealed area)	Europe	3-6 years	100m

		Dynamic World	Global	3-5 days	10m
		ESA WorldCover (Built-up classes)	Global	Annual	10m
Nature-oriented area on site	E4-5_12	Corine Land Cover + Ecosystem layers	Europe	3-6 years	100m
		IBAT : Integrated Biodiversity Assessment Tool, including Key Biodiversity Areas, the World Database of Protected Areas and the IUCN Threatened Species List)	Global	Periodic	Site-level (~1km)
Nature-oriented area off site	E4-5_13	Corine Land Cover (Off-site nature areas)	Europe	3-6 years	100m
		Dynamic World	Global	3-5 days	10m
Area covered by invasive alien species	E4-5_16	IUCN Invasive Species Maps	Global	Periodic	Varies (~1-10 km)
		GBIF occurrences (invasive species)	Global	Continuous	Point-level
		European and Mediterranean Plant Protection Organization (EPPO) Database	Global	Irregular	Country / Regional-level
All affected communities who can be materially impacted by undertaking are included in scope of disclosure under ESRS 2	S3.SBM-3_01	Indigenous Peoples and local communities (ICCAs)	Global	Regular	asset level
		Open Supply Hub	Global	Regular	asset level
		Global Legal Entity Identifier Foundation (used alongside geo data, such as Open Supply Hub)	Global	Regular updates	N / A
Description of types of affected communities subject to material impacts	S3.SBM-3_02	Indigenous Peoples and local communities (ICCAs)	Global	Regular	asset level
		Open Supply Hub	Global	Regular	asset level
		Global Legal Entity Identifier Foundation (used alongside geo data, such as Open Supply Hub)	Global	Regular updates	N / A

Type of communities subject to material impacts by own operations or through value chain	S3.SBM-3_03	Indigenous Peoples and local communities (ICCAs)	Global	Regular	asset level
		Open Supply Hub	Global	Regular	asset level
		Global Legal Entity Identifier Foundation (used alongside geo data, such as Open Supply Hub)	Global	Regular updates	N / A
Financial political contributions made	G1-5_03	EU Transparency Register (Political contributions)	Europe	Continuous updates	Entity-level (non-spatial)
		OpenSecrets (US lobbying & contributions)	US	Annual	National-level
		Global Integrity Indicators (Possible data)	Global	Irregular	Country-level
Amount of internal and external lobbying expenses	G1-5_04	EU Transparency Register	Europe	Continuous updates	Entity-level
		OpenSecrets (Lobbying expenses)	US	Annual	Federal-level
		LobbyFacts (EU lobbying data)	Europe	Periodic updates	Entity-level
Amount paid for membership to lobbying associations	G1-5_05	EU Transparency Register (Association membership fees)	Europe	Continuous updates	Entity-level
		OpenSecrets (Membership expenses proxy)	US	Annual	Federal-level
		LobbyFacts (EU lobbying association fees)	Europe	Periodic updates	Entity-level

About the Author

Dr Steven Owens is a member of the Financial Regulation Innovation Lab and the Applied Space Technology Lab at the University of Strathclyde. His work combines geospatial data and AI to address real-world challenges in environmental compliance and sustainability, with a particular focus on Environmental, Social and Governance (ESG) regulations and frameworks such as the EU Regulation on Deforestation (EUDR), the Corporate Sustainability Reporting Directive (CSRD) and The Taskforce on Nature-Related Financial Disclosures (TNFD). With focus on the social aspect of ESG regulations, he has recently led efforts to analyse the impact of deforestation on indigenous communities in the Brazilian Amazon due to mineral extraction. Prior to joining Strathclyde, Steve held a leadership role at a geospatial technology firm helping financial services integrate geospatial data into their daily operations. He holds a PhD in space technology, and has been working with industry to gain insights for over a decade.

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