NATIXIS CORPORATE AND INVESTMENT BANKING

GREEN & SUSTAINABLE **HUB**

CONNECTING THE DOTS

Geospatial big data for sustainable finance

Content

EXECUTIVE SUMMARY

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Location always mattered, both to measure **impacts and risks**; this is particularly true in sustainable finance, which made of the "where" an eligibility criterion in SDG finance[a]. Exposure to **natural hazards,** reliance on **ecosystems**, fulfillment of basic social needs, logistics routes, are known to be **influenced by geography**, from the outset. Henceforth, **access to geocoded addresses of millions of facilities,** for **hundreds of thousands of firms**, is a game changer. **Wide geospatial analysis across loan books or investment portfolios** is now within reach.

Value chains dots are increasingly **connected**, among themselves, and to **cartographic layers** provided by scientific bodies, satellites or drones. When **hard assets' latitude and longitude coordinates** are matched with cartographic layers – ex: heatmaps on land-cover/use, protected areas, wildfire hazards, water stress, chokepoint- **risk analysis can take a new dimension**. Shortly, this qualified data may support the **integration of newly unveiled risk exposure into credit risk assessments, pricing models, covenant design, and capital allocation**.

This **geodata supply & analytics breakthrough** sketches new financial uses cases. **"Geo-bigdata"[b]** uptake is spurred by supervisory pressure (ECB & EBA's stress testing and scenario analysis), **technological progress** (drones, satellite imagery resolution, machine learning and NLP[1]) and the **rise of nature on the political and business agendas** (incl. zero deforestation pledges). Point assets, but also linear or polygon assets (i.e. for spatially extended sites) are now geocoded, with additional characteristics such as physical form (ex: height, materials) or functional types (ex: office, warehouse).

Prior to **Geo-bigdata**, analysis was solely micro, or macro and top-down. Thanks to MSCI, S&P and the likes, *micro* analysis can become *meso* and then *macro*, through a bottom-up consolidation logic, which was previously inaccessible to financiers. Moreover, **the detection of critical situations at facility level** – ex: on deforestation risks– **is eased** through automated screening of large facilities samples, favoring financiers' engagement with assets operators.

Nonetheless, despite progress, **corporate asset data availability remains incomplete**. **Inventories of factories, pipelines, mines, power plants, warehouses** widely differ by sector and geographies. In emerging markets, where property registries and disclosure often lack, coverage is limited with high geocoding error rates. Mapping from facility to legal entity is further hindered by JVs or SPVs structures. Another challenge lies on **information shortage regarding the operating patterns, and productive or economic importance of each asset**—actual outputs, physical flows, asset efficiency, revenue/EBITDA by site. Hence, geospatial analysis predominantly captures **inherent risks exposure** overlooking actual hedging or risk-mitigation actions[c].

In some sectors, this lack of information on the **criticality of individual assets obfuscates consolidation**. The computation of vulnerabilities or impacts from micro to meso, and to macro, is then less rigorous and reliable. However, no one pretends that spatial information is self-sufficient. Building proxies is feasible through **blending with other data streams** on E&S governance, sub-ESG ratings, controversies screening, products labelling or certifications (ex: ISO). Impact investing could be another winner of the geo-bigdata revolution. Territorial context is key to impact measurement and delivery, therefore, higher frequency asset and area monitoring should spur impact finance.

[a]Financing of SDG territorial gaps bridging, factoring local distance to the SDGs targets. See case studies on Mexico, page 8.
[b]Considering the massive volumes of existing geospatial data, its variety of origins and formats, and expanding diversity and accessibility, it can be defined as geo-bigdata.
[c]Natural Language Processing

Part I. The "what" of geospatial data

This first part of the study describes what geospatial data is, where does it come from, how salient it could be, and which use cases it traditionally underpins.

I. Definition and features

Geospatial data, or geodata, are data that include information related to **locations on the Earth's surface**. Mapping objects, events, and other real-world phenomena to a specific geographical area identified by **latitude and longitude coordinates**. In the case of financial institutions, two main datapoints are necessary:

1. **Asset location:** in practice, an asset location is most often recorded as **latitude–longitude coordinates**, which are sourced directly from companies, or which are inferred from addresses.

Asset location data usually use three main geometric types:

i. **Point assets** represent discrete locations such as individual factories, offices, warehouses or wind turbines; a single coordinate pair often sufficices when the site is compact and when local hazard conditions do not vary much across it.
ii. **Polygons** describe the footprint or boundary of spatially extended sites, such as industrial parks, mining concessions, large farms, ports or solar parks which can span over kilometers; they allow analysts to capture variations within the site and to compute the share of the area which overlaps with specific hazard or nature layers.
iii. **Linear Assets**, by contrast, are spatially extended networks such as pipelines, transmission lines, railways, roads, waterways, and submarine cables. These assets span tens to thousands of kilometers and presenting varying characteristics. For instance, a 600-kilometer pipeline may present different diameters, materials, inspection histories, operational pressures, and environmental exposures at different segments. In short, linear assets require fundamentally different data structures and management approaches from point assets.

2. **Cartographic layers:** These are spatial datasets, in the form of **maps or heat maps**, describing the environmental or socio-economic context: water-stress indices, riverine and coastal flood hazard maps, wildfire hazard layers, land-cover and land-use maps, heat-stress indicators, protected areas, population density, employment or demographic situations, and so on. Matching asset locations with these layers yields powerful indicators such as "water stress level at site," or "share of site footprint overlapping with high-biodiversity-importance areas."

The combination of asset locations and cartographic layers already delivers a first-order view of physical and nature-related risks. However, this view can be significantly refined by introducing a third category of information:

3. **Asset characteristics:** This information consists of descriptive attributes of what an asset is, how it is built, and how it operates. These characteritics include **physical form** (height, footprint, materials, elevation); **functional type** (factory, data center, warehouse, port terminal, wind farm, etc.); **production processes** and **resource needs** (water use, cooling, continuous power, hazardous substances); **operational role** (core site, backup, hub, baseload vs peaking); and **economic importance** (share of group output, revenue/EBITDA by location, critical customer or regional role). These asset characteristics often enable or at least inform the qualification of the criticality of a given asset for a corporate.

Combining these characteristics with **location and hazard layers allows a more nuanced assessment of risk exposure**. For example, two facilities which are in the same modeled floodplain can have very different vulnerabilities: a ten-story office building with critical equipment located on higher floors will generally face lower flood loss than a single-story manufacturing plant with ground-level machinery and sensitive process lines. The granularity of this information offers direct insights into a site's specific hazard vulnerability, circumventing the use of industry-sector proxies. This level of information facilitates using "residual risk" rather than "inherent risk".

II. The variety of data sources

Geospatial asset data is sourced from multiple sensor modalities, which can be distinguished by their primary applications: gathering detailed data on specific **corporate assets** or creating broad **cartographic layers** for contextual analysis.

Machine Learning and Computer Vision for Asset Detection and Linking

Collecting assets coordinates increasingly relies on machine learning and Natural Language Processing (NLP).

Large Language Models for Disclosure Analysis

New large language models (LLMs) and Natural Language processing (NLP) can automatically read sustainability and climate reports and pull-out structured information: what assets a company owns, their addresses, what climate or nature-related risks it mentions, and what management practices it reports. This adds context to the physical and satellite-based data and helps build a more complete picture of asset-level ESG characteristics. Models can also infer supplier–customer relationships, and then link them to map coordinates. This makes it possible to build multi-layer supply chain maps, which are essential for understanding how climate policies or climate-related disruptions might affect a company's operations.[1]

Object Detection and Segmentation

Deep learning models can process satellite images, automatically find assets and outline their physical characteristics. A 2025 study on arXiv, for example, built a global database of more than 375,000 wind turbines and over 86,000 solar sites from satellite data, with results that closely matched established capacity data.[2]

Change Detection

Comparing satellite images taken over time, enables to see where assets are being built, expanded, or shut down. The same methods can be applied to track environmental changes: loss of vegetation from deforestation or wildfire, changes in lakes and rivers due to drought or flooding, shifts in nighttime lights that signal economic activity, and damage to buildings after storms or other disasters.

Property Condition Assessment

Computer vision models, which are trained on properties' photos and historical insurance or claims data, can infer how "healthy" a building is just from imagery. They can estimate roof age and material, building height and density, nearby vegetation that might act as a firebreak, and the extent of paved surfaces in the surrounding area, which affects flood risk. Cape Analytics, for instance, generates a Roof Condition Rating on a five-point scale for each property. This single score has proven strongly predictive of both insurance losses and borrower default risk.[3,4]

Data Sources for Cartographic and Contextual Layers

Broad-area cartographic layers provide context for asset location and regional environmental changes.These are primarily built using satellite imagery due to its wide coverage and consistent revisit cycles.

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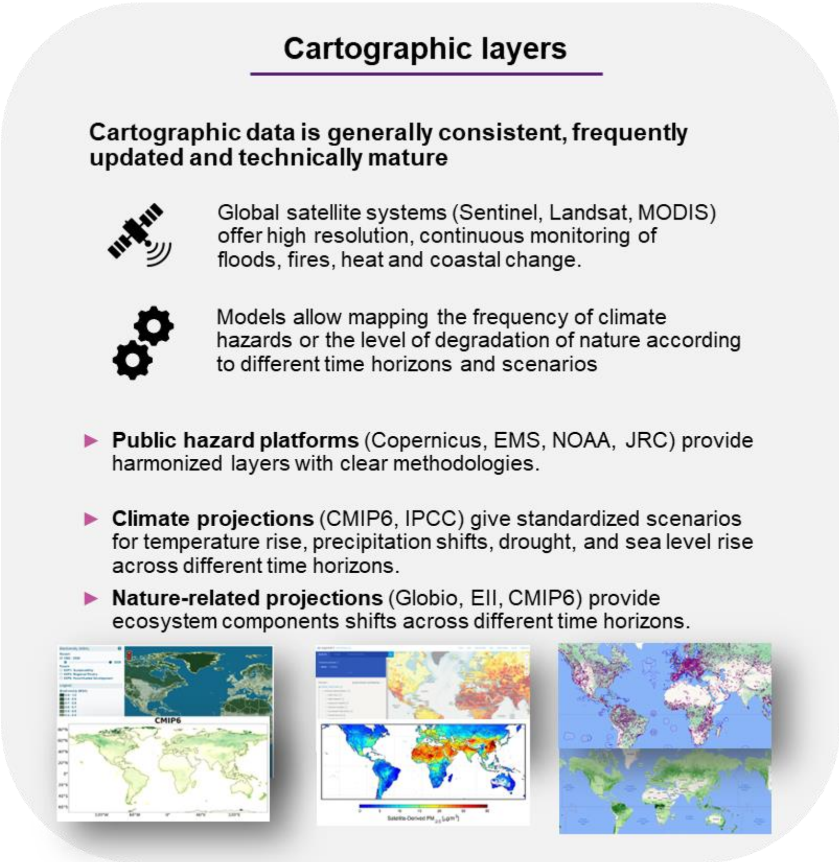
[1] Using Natural Language Processing for Supply Chain Mapping: A Systematic Review of Current Approaches, Schöpper and Kersten, 2021, available here

[2] Global Renewables Watch: A Temporal Dataset of Solar and Wind Energy Derived from Satellite Imagery, Robinson et. Al., 2025, available here

[3] Machine Vision in Finance – Current Applications and Trends, 2018, available here

[4] Geospatial AI for Distressed Loan Analytics, 2020, available here



Satellite imagery
Optical and radar satellites are the primary source of multi-temporal and consistent asset location and physical condition data. Key satellites used in financial applications include:

- **Landsat (USGS/NASA)**: Offers 30-meter spatial resolution with a 16-day revisit cycle and has been operating since 1972, providing the longest continuous imagery record for monitoring change over time.[5]
- **Sentinel-2 (ESA):** Provides 10-meter (four bands), 20-meter (six bands), and 60-meter (three bands) resolution, with a 290-kilometer swath and a 5-day revisit interval at the equator using multiple satellites. It is generally more effective than Landsat for land-use change detection, vegetation analysis, and facility mapping.[6]
- **Harmonized Landsat–Sentinel (NASA/ESA):** Combines and radiometrically harmonizes Landsat and Sentinel surface reflectance data at 30-meter resolution, achieving a 2–3 day global revisit frequency and enabling higher-frequency asset monitoring. Such a frequency enables monitoring of flows, stock, and inventories in certain contexts.[7]
- **Synthetic Aperture Radar (SAR):** SAR satellites emit their own microwave signals and measure the echo coming back from the ground. SAR missions (e.g., Sentinel-1) deliver cloud-independent imaging and can reveal flooding, land subsidence, and structural deformation.

[5] Landsat Surface Reflectance available here
[6] Sentinel-2, Copernicus, available here
[7] Earth data, NASA, available here

III. Availability, coverage & quality stocktake

Despite progress in satellite observation and climate modelling, c**orporate asset location and their characteristic data remain a geospatial analysis bottleneck.** While cartographic hazard layers are increasingly global and standardised, systematic geo-referencing of productive assets (factories, pipelines, mines, power plants, warehouses) remains a more recent and unevenly achieved development.

Corporate asset data availability differs widely by geography and sector. Developed markets like the US, Western Europe, and Japan have detailed property registries and disclosures that provide addresses and basic attributes for tens of millions of commercial and industrial buildings: energy, utilities, and mining facilities often geo-coded at 50–70% coverage because of strict permitting and reporting. In contrast, many emerging markets lack systematic registries, suffer geocoding error rates above 30%, leading to only 20–40% coverage in cities and near-zero visibility for rural industrial sites.[8]

Three data quality issues limit financial use so far:

- Positional accuracy is reliable for GPS data but often poor for manually geocoded addresses, which misaligns facilities with fine-scale hazard maps. Indeed, for assets spanning on large portions of land, risk levels may differ whether it is at the entrance of the asset (address), in the middle or the edges. Polygons are still quite scarce although they would provide more accuracy.
- Characteristics (as defined in I.) completeness is weak outside regulated sectors: satellites infer basic physical traits (identify a parking lot versus a factory or distribution center), but internal processes and economic metrics still rely on proxies.
- Mismatch in asset observed and actual status resulting in obsolete records of closed facilities ("ghost assets") and unrecorded site expansions.

IV. Location matters: financial use cases

Location and local context are fundamental to (sustainable) finance, because issues such as climate adaptation, biodiversity loss, and access to essential services, are inherently location-dependent and require approaches tailored to different geographical settings.

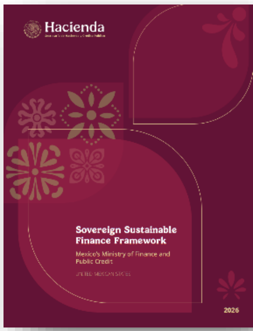
Insurers have a longer history of using geospatial data to price premiums and facilitate asset-level compensation for damage (parametric insurance), as they typically underwrite individual assets, not (only) entire companies. AXA, for example, is using satellite imagery for parametric insurance solutions, particularly in agriculture and disaster response. Swiss Re, as a global reinsurer, is at the forefront of catastrophe modeling and risk analytics, which requires extensive geospatial data to understand hazard zones, property characteristics, and their interplay. Integrating these geospatial indicators with **forward-looking environmental scenarios** enables more granular stress testing of portfolios under different climate trajectories, **informing risk-weighted asset calculations** and **capital buffers**.

While sustainable finance frameworks historically focused on the "what" – categorizing eligible projects or activities like renewable energy or affordable housing – the "where" and "compared to what" are equally crucial. **Finance detached from its geographical roots sometimes struggles to demonstrate actual impact.** This is apparent in climate change adaptation, where physical consequences differ vastly from one area to another. Access to essential services like healthcare and education also has a strong geospatial dimension. With spatial data, counterfactuals and additionality can be more easily evidenced.

Targeting requires localization. Sustainable finance ultimately aims to deliver tangible benefits and impacts. This makes the notion of target populations, and crucially, **target territories**, paramount. The

8 MSCI, Hiding in Plain Sight

global agenda for sustainable development, while universal in its goals, faces its **most significant gaps at the spatial and local levels**. Disaggregated data at sub-national level overcame national averages limits, allowing to address, or at least identify, regional disparities.



For instance, geospatial data played a central role in **Mexico's SDG bond issuances** by underpinning the framework's geospatial eligibility criteria and impact reporting. The sovereign framework links budgetary items to the SDGs using **granular geospatial analysis to identify municipalities with the highest SDG gaps**, ensuring that the proceeds of their issuances fund targeted projects within 1,345 towns. This spatial lens directs financing toward **areas with acute needs**—such as literacy, health, sanitation, and electricity access—while open governance and public data sharing enable investors to verify location-based eligibility and track outcomes. The process leverages **census data, INEGI[9] mappings, and ministry inputs** to create feedback loops for impact reporting.

From a social/impact perspective, geospatial data also allows "impact by design" approaches. In practice, this means directing or earmarking financing and investments to where it can have the greatest impact—for example addressing "SDG Gaps" or improving access to essential services where it is the most lacking.

Social impact bonds are also incorporating **location-based eligibility** criteria to drive local economic development, specifically by channeling funds to SMEs in disadvantaged areas, as demonstrated by **BPCE's** framework. This is achieved through a **geo-scoring system** that identifies regions within the bottom third for poverty or unemployment rates and also shows weaker business creation levels, ensuring investments target communities with the greatest need and potential for growth, often leveraging publicly available demographic data.

Logistics, trade dependencies and chokepoints mapping to unveil geopolitical risks

The value add of geospatial information is outstanding to unveil **great power rivalry consequences**. It allows **geopolitical risks discovery** through value chains mapping and screening of hard assets GPS coordinates, which can help identify **trade or logistics chokepoints**. It is increasingly used for **security of supply analysis**, but also for "strategic autonomy" related thematic investing. The latter aims at selecting firms whose manufacturing basis and/or clients basis (incl. revenues) are less vulnerable to geopolitical shocks due to **regions splits of sourcing, manufacturing or revenues**. Meanwhile, geospatial information is obviously highly instrumental regarding **local content requirements and "Made in" initiatives** (such as the EU Industrial Accelerator Act, following the Net Zero Industry Act). This present study is not dedicated to geospatial information on geopolitics, our know-how on the topic – and on the entanglement between energy transition and security – will be incorporated into a future report.

[9] INEGI is Mexico's National Institute of Statistics and Geography, more information available here

Part II. Geospatial big data era: mainstreaming drivers

This second part of the study explores, beyond technological progress (drones, satellite imagery resolution, NLP), the multiple factors which spurred a quantum leap in geospatial information access, it also details some of the data vendors' offer. The mainstream use of geospatial data is currently supported by EU regulations (EBA, ECB, EUDR), multiple standards and initiative such as the Taskforce on Nature-related Financial Disclosure (TNFD).

I. The risk supervisory pressures

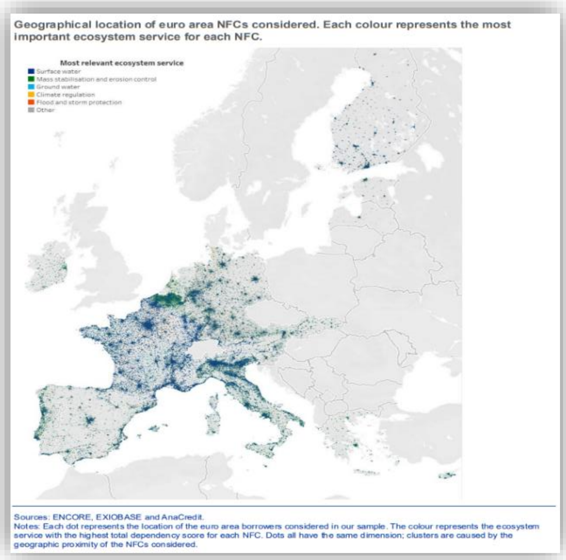
As of early 2026, both the European Banking Authority (EBA) and the European Central Bank (ECB) are promoting the **mainstreaming of geospatial data use within financial institutions**, driven by, risk management needs, and the push toward data-driven supervision and supervisory convergence.

ECB and EBA scrutiny & requirements

The ECB leverages geospatial data to **map regional systemic risk exposures**, to assess concentration risk in real estate markets, and to monitor climate physical risk vulnerabilities. It considers nature-related impacts and dependencies as relevant for **financial stability monitoring**.

The ECB incorporates **location-based climate risk into supervisory stress tests and climate stress scenarios**. Geospatial layers (e.g., flood zones, wildfire risk, sea-level rise) feed into climate risk assessments, asset quality reviews, and capital planning.

Figure 1 : The most relevant ecosystem for economic production across Europe



The ECB's **nature-related stress test** mainstreams geospatial data by turning location-specific biodiversity and ecosystem-service information into bank-level credit risk signals within a formal stress-testing exercise. It uses the following datapoints:

- **Coordinates of euro area borrowers:** The ECB uses the addresses and coordinates (latitude, longitude), of EU borrowers to locate them on the continent. The data comes from AnaCredit, a **comprehensive database of granular credit data** on legal entities in the euro area, collected by the European Central Bank (ECB) and national central banks (NCBs).

- **Biodiversity shocks (cartographic layer):** The exercise uses GLOBIO's mean species abundance (MSA) cartographic layers as a proxy for biodiversity changes, projected to 2050 under multiple scenarios and anchored at country and water-basin levels. These biodiversity shocks enable region-specific risk assessments rather than purely national aggregates.
- **Transmission mechanism:** Geographic biodiversity shocks feed into proxy of ecosystem services disruptions which would feed borrowers' Probabilities of Defaults (PDs) assessments based on their dependencies through their asset locations and that of their supply chains. The resulting PDs are used to derive expected losses (EL) at bank and country levels, linking ecological change to credit risk.

The ECB demonstrated what simple models could do. In the same spirit, the IPBES[10] confirmed in February 2026 that economic actors **should not wait for the perfect metrics and models to start better assessing nature-related risks**, so much is yet to be done with what is available.

The EBA also supports integrating geographical risk layers into risk scoring, stress testing, and scenario analysis for climate-related financial risk. This includes exposure to weather events, flood plains, and regional climate projections to better gauge potential losses and capital requirements.

Indeed, in its Guideline on the management of ESG risks[11], the EBA strongly advise to collect or obtain "**geographical location of key assets** (e.g. production sites) and **exposure to environmental hazards** (e.g. temperature-related, wind-related, water-related, solid mass-related hazards) at the level of granularity needed for appropriate physical risk analysis, and availability of insurance".

Within its Guidelines on environmental scenario analysis, the EBA requires institutions to "ensure industry sector and country or geographical location dimensions are properly taken into account in their stress test models."[12]

Although the EBA is clearly pushing for geospatial data integration, it provides little guidance on the second most important datapoints within geospatial analyses: cartographic layers

The NGFS plea for location specific scenario analyses

The Network for Greening the Financial System (NGFS) increasingly incorporate region- and asset-level geographies (countries, regions, cities, flood plains, heat-stress zones) in its scenarios to reflect **spatial heterogeneity in risk**.

According to a NGFS study, "*excluding physical assets and locations other than headquarters grossly underestimates exposure to climate hazards, with existing research having estimated that up to 70% of expected investor losses may be missed.*"

Scenarios address biodiversity loss, ecosystem service degradation, land-use change, and natural capital depletion, **using spatial datasets to illustrate where risk concentrations may emerge** (e.g., flood-prone coastal areas, drought hotspots).

[10] IPBES Business and Biodiversity Assessment: Summary for Policymakers, February 2026, available here
[11] EBA guideline on ESG risks, available here
[12] EBA guideline on on environmental scenario analysis, available here

Scenarios further map climate impacts onto geographies, showing where banks’ real assets, collateral, and loan portfolios are concentrated, and how those geographies shift under different pathways.

NGFS materials encourage banks to translate geospatial risk into probability of default (PD), loss given default (LGD), and exposure measures at regional or facility level, enabling more accurate stress testing.

II. Data providers stepped up their offer

Several data vendors have significantly expanded both their corporate coverage and the number of mapped asset locations. Private databases now offer increasingly comprehensive datasets, with more than **two million geocoded asset locations** (latitude and longitude) **across thousands of companies.**

Sample of geospatial data providers

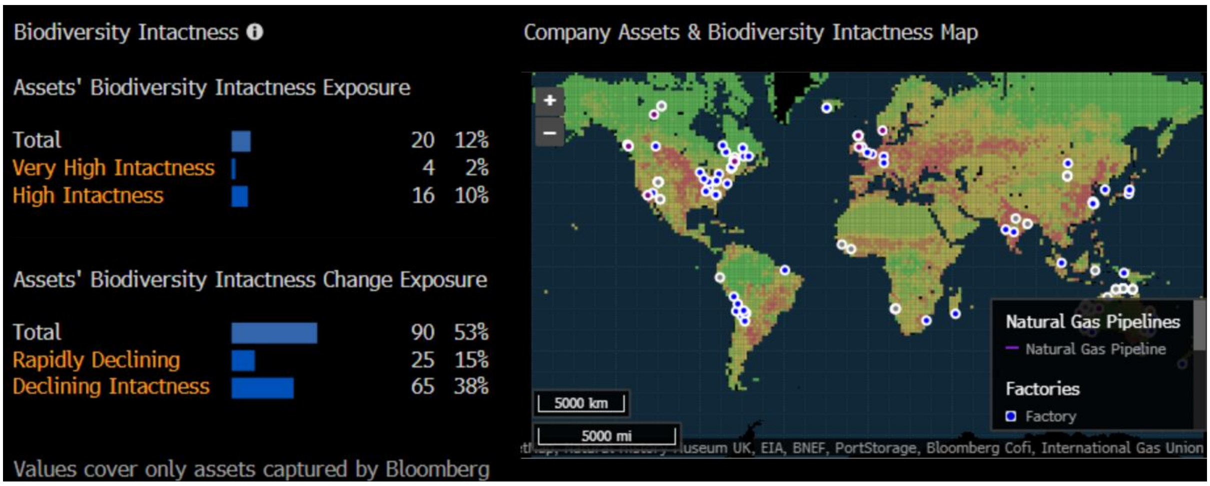
In addition to asset locations, these providers offer **sectoral categorization of activities per asset, specific production figures, and turnover splits by main activities, as well as associations with parent groups or companies.**

As early as 2021, Bloomberg terminals provided geospatial data and mapping tools (satellite overlays, and asset-location layers) to enable robust assessment of physical climate risks and sustainability risks. Bloomberg is cited in this paper due to its wide use in the financial sector but other data providers offer similar products.

Bloomberg provides **a spatial view of risks**—linking asset locations, supply chains, and climate-sensitive zones—to **inform investment decisions, ESG reporting, and risk supervision**.

In 2024, Bloomberg's Biodiversity Intactness Index became available on terminals. Matching these layers with corporate asset locations collected by Bloomberg offers market participants relevant geospatial insights.

Providing all Bloomberg users with easy access to these datasets through visual and synthetic assessments strongly contributes to geospatial adoption within financial markets.



Although Bloomberg's geospatial data service is valuable in enabling terminal users to access corporate asset data, it is far from the only data being used by finance professionals. From usual suspects like **MSCI, S&P and Moody's** to specialised environmental data intelligence providers such as Kayrros and Climate X, the universe of corporate asset data providers is broad, with each offering different competitive advantages for different needs.

MSCI's GeoSpatial Asset Intelligence is an asset-level geospatial layer embedded in MSCI's ESG and climate platform for investors, banks and insurers. It maps precise coordinates for c.4 million locations linked to 700,000+ companies worldwide, classifies them into 40+ asset categories, and overlays 28 physical hazards (e.g., flood, heat, drought, wildfire, cyclone, water stress) plus nature-related metrics. The platform provides asset-level financial impact estimates (e.g., damage probability, business interruption duration), integrates with MSCI's corporate and real estate datasets, and is designed to support regulatory reporting such as the EU Taxonomy and ISSB standards.

Oliver Wyman's Sentrisk is an AI-powered supply chain risk management platform that maps and assesses multi-tier vulnerabilities using geospatial and procurement data. For a sample of 100 Tier 1 suppliers, it uncovers 700+ Tier 2 suppliers and 4,000+ Tier 3 suppliers, scaling to millions of suppliers worldwide across client analyses, with risks assessed at site/supplier/component/route level rather than publishing a fixed global asset database like its peers.

Specializing in geospatial intelligence, **Kayrros** leverages satellite imagery and AI to directly observe and quantify activity at over 200,000 industrial and energy assets globally, delivering independent, empirical datasets on emissions, production, land-use change, and climate hazards. Its NPL/ML models power high-precision detection of asset footprints, methane plumes, storage levels and environmental impacts that often reveal discrepancies with corporate self-reporting, enabling regulators, energy majors and investors to validate transition progress and physical risk exposure with directly observed data rather than modelled proxies.

III. The rise of nature and deforestation concerns

Nature is becoming a center stage preoccupation for financial institutions and corporates. Large scale datasets have been bridging the gap between corporate level synthetic biodiversity footprints and site level assessments. **Linking global trends with local realities**, such datasets allow to stress corporate assets to a degrading ecosystem putting production processes at risk.

While nature-related location-specific assessments are still in their early stages, they offer tremendous opportunities for improved risk management. Recent pieces of research are building more sophisticated nature stress testing models[13] reflecting nature's complexity through its different components, from soil to air and species.

[13] Nature stress testing and value at risk Pineau et. Al. available here

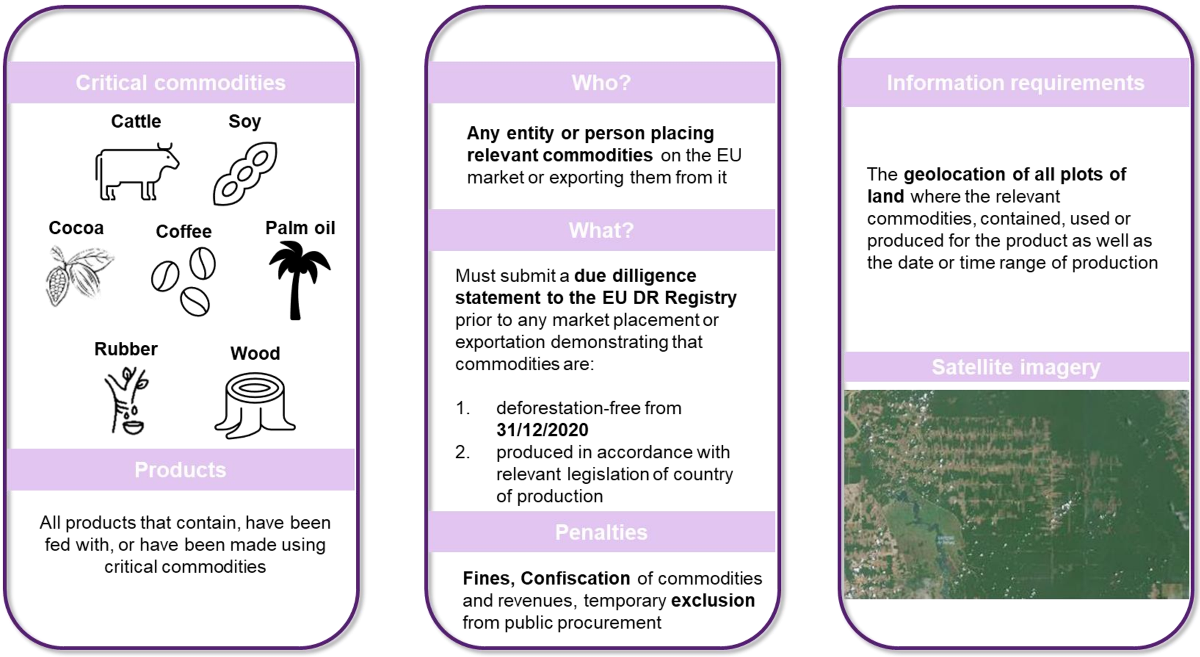
> ***“Combining cartographic layers to assess ecosystem health and its capacity to deliver ecosystem services to corporate assets helps qualify risk levels and incentivize corporate in halting and reversing nature loss locally as a hedging measure.”***

Deforestation: grounding due diligence in location-based data

Regulations, especially concerning deforestation, also drive the need for location-based supply chain monitoring.

The **EU Deforestation Regulation (EUDR),** whose application is postponed for the time being, is driving corporates and financial institutions to integrate geospatial data and related analytics as a core part of due diligence, risk management, and reporting processes.

What is the EU deforestation regulation?



The EUDR requires critical commodities operators to **assess and verify supply-chain risk for products linked to deforestation**. This translates into operators pinpointing commodity production sites and **monitoring land-use changes over time.**

The Regulation requires **traceability across the supply chain**. Geospatial data (farm/land parcels, deforestation hotspots, forest degradation zones, parcel-level maps) supports end-to-end mapping from producer to product. Banks and asset managers are increasingly assessing their clients’ exposure to deforestation risk in lending, investment, and credit risk models. This incentivizes integration **of satellite imagery**, **land-cover data, and geospatial risk maps to evaluate where deforestation risk concentrates in a borrower’s / investee’s supply chain**.

Platforms and data services that provide deforestation risk scoring by geography become more relevant to financial decision-making, expanding from pure financial metrics to geo-spatial risk indicators.

Lenders may incorporate deforestation risk metrics into pricing through sustainability-linked mechanisms, covenants, and collateral assessment. Typically, Côte d’Ivoire’s sustainability-linked loan with the World Bank[14] is a recent relevant example. The structure includes two forest cover-related targets:

i. Reducing forest-cover loss to no more than 300,000 hectares between 2025 and 2030 and;
ii. Converting 1 million hectares to forest cover by 2030.

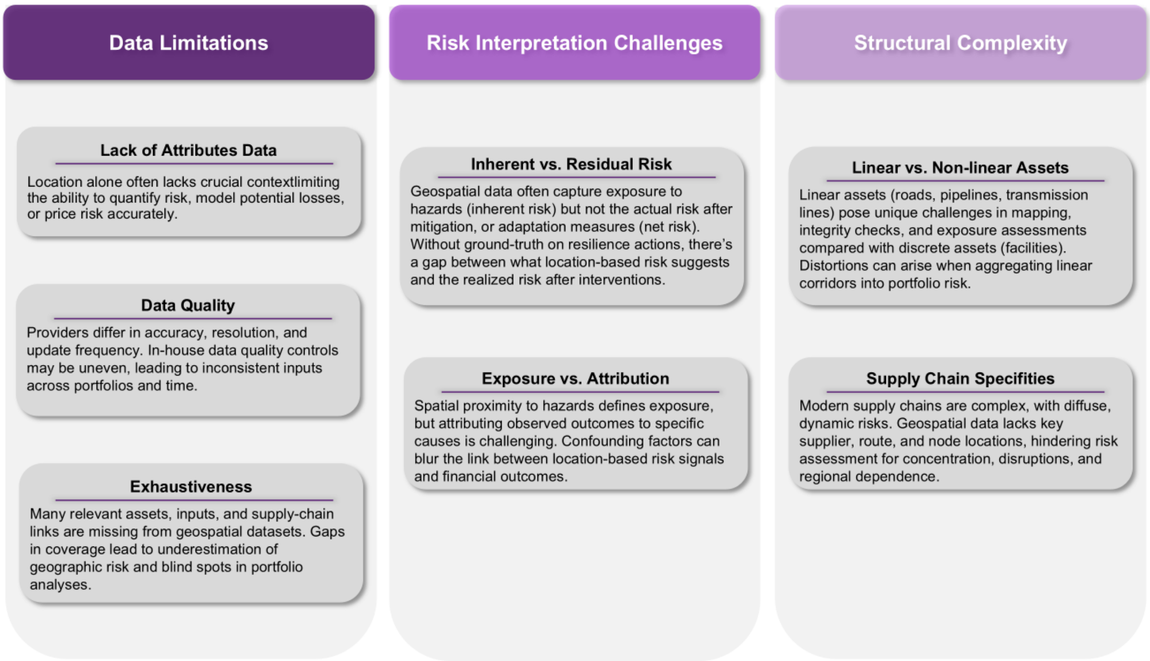
In that case, geospatial monitoring is core to the verification of the country's performance relative to the target. Regular remote-sensing monitoring (satellite imagery, land-use change detection) feeds KPI reporting to lenders. This provides **objective and observable evidence** of progress toward 300k ha avoided loss and 1 million ha of new forest cover by 2030.

Illustration of satellite imagery showing land use change over time

[14]Côte d'Ivoire launches innovative financing linking millions to ambitious sustainability goals, the World Bank, available here

Part III. Overcoming geodata limits

This third part of the study highlights the current limitations of geospatial data (shortcomings were preliminary explained detailed in Part I., III availability, coverage & quality stock-take), how they can be surpassed, but also the synergies with other data streams and tools.



I. Data gaps impeding full supply-chain view

Supply-chain science reveals further blind spots. Geospatial data are generally robust for **directly owned assets but lose reliability along upstream and downstream value chains**, where a large share of climate and nature-related risk often resides—particularly in agriculture, extractives, and manufacturing. The challenge intensifies for **firms with complex value chains or business models not anchored in asset ownership**. The Task Force on Nature-related Financial Disclosures (TNFD) notes that identifying the locations of both direct operations and supply-chain assets is fundamental to assessing nature-related risk, but geospatial analysis and disclosure of detailed asset locations remain difficult for companies **with intricate value chains**.[15]

Consequently, even when banks or asset managers have good geospatial data on a client's own plants and warehouses, they still face **large blind spots from Tier-1 to Tier-3 suppliers in high-risk regions** and **around downstream distribution, use and disposal pathways**, where environmental impacts and liabilities often crystallise. At portfolio level, this results in a structural bias: direct operational exposures are visible and quantifiable, while **many embedded supply chain exposures, especially in emerging markets and informal sectors, remain only partially captured or entirely invisible.**

[15] Guidance on value chains, TNFD, December 2025, available here

II. Data needs to distinguish inherent vs. residual risks

The lack of asset-level characteristics hinders the capacity of financial institutions to consider reliable evidence of resilience in risk assessments. Although asset locations may be known, details on **the type and quantity of inputs and outputs at individual assets** are frequently unavailable. This gap hinders precise exposure analysis for risks such as water scarcity or resource constraints. Some sectors, notably power utilities, tend to have relatively better asset-level data—such as capacity in megawatts—which improves granularity, but even in these cases**, a complete risk picture remains elusive without comprehensive input–output data and information about how facilities are operated and maintained**.

Geospatial analyses tend to capture inherent exposure rather than the effectiveness of hedging or adaptation actions on the ground. Corporate annual reports often lack detail about mitigation strategies or their effectiveness, making it difficult to gauge how well companies are actively managing geographic risks. It is probably due to the lack of data at consolidated corporate level or the willingness to prevent sensitive data from becoming public. From an analytical perspective, this means that asset-level geospatial insights should be complemented with **qualitative information on governance and adaptation measures** to form a more complete risk picture, both at facility and entity-level when relevant and feasible.

Consequently, two facilities in the same modeled hazard zone may face very different real-world risk profiles due to differences in design standards, defenses, and equipment placement. Yet standard overlays may treat them as equally risky. This underscores the distinction between exposure and vulnerability and cautions against assuming that spatial signals equate to expected losses. The Bank of England's 2021 Climate Biennial Exploratory Scenario reports emphasizes that gaps in asset-level vulnerability data **constrain physical risk assessment**. Therefore, current geospatial outputs should be treated as upper-bound indicators of potential exposure, to be calibrated downward when reliable evidence of resilience or adaptation exists.

III. Challenges in impact attribution & portfolio consolidation

Even when asset locations and hazard overlays are available, turning spatial exposure into instrument- and portfolio-level risk metrics requires **several attribution steps that geospatial data alone cannot resolve**:

- Mapping from facility to legal entity, including cases with **joint ventures, special-purpose vehicles or split ownership;**
- **Consolidating asset-level, location-based assessments into a coherent company-level risk view is notably challenging**. We lack reliable data on the relative importance of individual assets—for example, their capacity, inputs and outputs, asset type, and the value each asset adds. Without this asset-level criticality information, aggregating risks across assets to produce accurate, portfolio-wide metrics remains uncertain and prone to misrepresentation.
- The translation of physical risks (climate or nature) into financial metrics (increased probability of default) is an area for development.
- Consolidating exposures across portfolios while avoiding double counting due to cross-holdings or complex group structures.

Commercial providers, such as MSCI, help by linking millions of corporate and real-estate locations to hazards and offering portfolio-level aggregation tools, but these services do not fully resolve the data gaps or the complexities of ownership and attribution. Beyond mathematics, proving causal links between observed environmental degradation and facility-level activity remains difficult without direct input-output data; correlations and proxies, such as public sentiment or media coverage, can offer clues but are imperfect[16].

Final recommendations

Considering aforementioned data limitations, a pragmatic path forward for financiers would combine **asset-level geospatial insights with complementary streams of information and a staged implementation:**

1. Treat spatial information “only” as a signal informing about the situation surrounding a facility, and possibly documenting a trend, rather than precise predictions of loss.
2. Calibrate exposure signals downward when strong evidence of resilience or adaptive capacity exists.
3. Combine **geospatial signals** with governance context, policy developments, on-the-ground disclosures, and third-party risk assessments to triangulate resilience.
4. Where possible, **incorporate supply-chain data** to inform upstream and downstream risks, moving from direct asset exposure to broader value-chain risk as data quality improves.
5. **Embrace a phased attribution approach**: begin with direct asset mapping and gradually incorporate upstream and downstream layers, remaining mindful of the risk of double-counting and the complexities of cross-holdings.

In summary, **large-scale asset-level geospatial analysis** holds significant promise for revealing location-specific climate and environmental risks, as well as geopolitical ones (trade chokepoints), and for connecting local risk signals to global trends and concerns. Yet current limitations in uniform global coverage, asset-level detail, and end-to-end attribution constrain precision.

Until now, most geospatial data have been gathered, estimated, and reprocessed by external third parties and only partially disclosed by firms themselves. Could this change? Companies may be willing to publish more exhaustive asset-level data to offset gaps or errors in third-party information. They may also disclose **detailed facility-level or facility-type mitigation measures**.

A robust approach blends geospatial insights with qualitative governance information and comprehensive supply-chain data, **treats spatial exposure as a prospective risk signal rather than a definitive forecast**, and remains adaptable as datasets and methodologies continue to improve. This balanced view supports **more informed risk pricing, targeted engagement, and smarter capital allocation**. By embracing localization and leveraging the power of geospatial data, we can move towards a finance that is not only responsible but also deeply effective in **addressing and pricing the diverse and complex challenges of our planet and its people.**

[16] There is often a lack of detailed, facility-level information on how operators mitigate risks, and corporate disclosures rarely provide an in-depth view of mitigation strategies or their effectiveness. Beyond asset or facility-level data, information on the people involved—whether employees, riverside communities, or end customers—is also essential for assessing both risks and opportunities. To address this challenge labor, customer or population censuses can offer valuable data, despite the geographic mobility of those protagonists.