

Geospatial Trends 2021:

Opportunities for data.europa.eu from
Emerging Trends in the Geospatial Community

The logo for data.europa.eu features the text 'data.europa.eu' in a white, lowercase, sans-serif font. Each letter is accompanied by a small, colored dot (yellow, red, blue, or orange) positioned above or below it, creating a stylized, dot-matrix-like effect.

data.europa.eu

The official portal for European data

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1 Introduction

The goal of data.europa.eu is to improve accessibility and promote the re-use of public sector information. The portal provides access to open data from international, EU, national and regional sources. This is done by collecting the metadata of public data made available across Europe in a process called “harvesting”. Metadata is harvested both from open data portals and geodata portals and is made available on data.europa.eu.

Geospatial data contains information on properties or conditions that are linked to a position on earth. Looking at the geospatial context – the “where” – of a phenomenon will often uncover interesting correlations or revelations. It is an important feature of data.europa.eu to facilitate the discovery and access to open geospatial data sources.

Geospatial data has been identified as a type of high-value dataset (Annex 1 of Directive (EU) 2019/1024¹), and a considerable number of data sources on the future data.europa.eu will contain geospatial references. There have been several standardisation efforts in recent years related to the publication of spatial data (e.g., W3C/OGC working group on Spatial Data on the Web² and the new OGC API family of standards³), which may lead to further ways of finding and using “spatial things” as well as new approaches for harvesting their metadata.

As part of the data.europa.eu mission to support European countries in increasing their open data maturity and promoting re-use, the adoption of new trends for publishing geospatial data will be monitored and their relevance for data.europa.eu will be explored on a yearly basis. The focus of this exercise is to identify opportunities from emerging trends in the geospatial community and explore how data.europa.eu can support and benefit from the new ways in which geospatial datasets are offered. The results are documented in this short report.

2 Trends

In this report, a trend is understood to be a recognizable tendency or direction of development, or to quote the Cambridge Dictionary the “*general development or change in a situation or in the way that people are behaving*”⁴.

Two major trends in publishing geospatial data that are relevant to data delivery and discovery were identified:

- (1) A new generation of geospatial standards: OGC API family of the Open Geospatial Consortium (OGC), and
- (2) High-value datasets (HVDs) and the Open Data Directive

¹ <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1561563110433&uri=CELEX:32019L1024>

² <https://www.w3.org/TR/sdw-bp/>

³ <https://ogcapi.ogc.org/>

⁴ <https://dictionary.cambridge.org/dictionary/english/trend>

While there are other trends affecting the geospatial community (Copernicus, GAIA-X, European Data Spaces, Geospatial Knowledge Infrastructure, Digital Twin, Smart Cities, etc.) the two chosen topics seem especially relevant and tangible for data.europa.eu because they constitute a change in how geospatial data is published, delivered, and discovered. As these new options are adopted it can be expected that they will become relevant to data.europa.eu because of rising expectations that geodata made available in this way can also be found and accessed on data.europa.eu.

2.1 New Generation of Geospatial Standards

Interoperability standards for geospatial information are an important foundation to facilitate the discovery and sharing of (open) data resources. For example, interoperability standards address the following aspects:

- Common metadata: how to describe geospatial information?
- Common data formats: how to encode geospatial information?
- Common interfaces: how to discover and access geospatial information?

These standards are relevant to data.europa.eu:

- Common metadata formats enable the harvesting of information about available data sources.
- Common data formats and interfaces help users to work with these data sources and make functionality such as previewing geospatial data as part of data.europa.eu possible. The use of such common standards is a central element of the European INSPIRE directive and framework which is an important source of geospatial information for data.europa.eu.

Over the last years, there have been several activities in the standardisation community in order to advance the current standards to more mainstream, lightweight, and developer-friendly approaches. More specifically, there is a trend to move from XML/SOAP based patterns to REST and JSON-based solutions. This is reflected by a new generation of geospatial interoperability standards which are expected to help increase the acceptance of interoperability standards by lowering the necessary implementation efforts. The following paragraphs will describe both the OGC API family of standards and the OGC SensorThings API. Opportunities resulting from these developments for data.europa.eu are summarized in chapter 3.

2.1.1 OGC API Family

Based on the existing baseline of standards, such as the OGC Web Map Service (for viewing maps) or Web Feature Service (for downloading vector data), a new generation of standards is currently being developed. Modern web-based Application Programming Interfaces (APIs) are meant to be “implementer-friendly” so developers can use them even with limited preliminary knowledge.

These standards are based on mainstream IT/Web technologies and design patterns such as OpenAPI⁵, REST and JSON.

⁵ <https://github.com/OAI/OpenAPI-Specification>

The result is the OGC API family of standards⁶. Besides the common technological foundations, these standards will follow a common approach defined by the OGC API - Common specification⁷.

The OGC API suite comprises several standards addressing different needs when building spatial information infrastructures:

- OGC API Features: Provision of vector data (*adopted*)
 - part 1 (core)
 - part 2 (coordinate reference systems)
- OGC API Maps: Provision of rendered maps (*in progress*)
- OGC Environmental Data Retrieval API: Access to environmental data (*adopted*)
- OGC API Records: Discovery of geospatial resources (*in progress*)
- OGC API Processes: Invoking the processing of geospatial data to derive, for example, further information products (*adopted*)

OGC API Features and OGC API Records are especially interesting for data.europa.eu and will be discussed in the following chapters. OGC API Features is already approved and gaining more and more acceptance so that it would be a valuable additional type of data source. While OGC API Records is not yet published as a standard, its impact towards new approaches for harvesting metadata may also become useful for data.europa.eu.

2.1.1.1 OGC API Features

The OGC API Features standard defines functionality for providing access to vector data. Thus, it can be considered a continuation of the functionality offered by the OGC Web Feature Service (WFS) standard. However, compared to the WFS standard, the OGC API Features offers more convenient functionality to explore and access the offered content.

For example, the OGC WFS standard strongly relied on XML-based data exchange. This made it rather difficult for users, to directly interact with such servers. Compared to this, the OGC API Features also supports the JSON- and HTML-based representation of content. The use of a common output format such as GeoJSON could be taken up by the geo-data visualisation of data.europa.eu, by also supporting visualisation of OGC API Features. Furthermore, the support of HTML output makes it possible, that users directly interact with OGC API Features servers by browsing through the available datasets. Relying on this functionality, data.europa.eu would be able to provide users with direct references, in order to explore the data available via an OGC API Features endpoint.

2.1.1.2 OGC API Records

Another element of interest from the OGC API family of standards is the OGC API Records. This standard is currently available as a draft⁸. It will offer discovery functionality comparable to the OGC Catalogue standard (CSW).

⁶ <https://ogcapi.ogc.org/>

⁷ <https://github.com/opengeospatial/ogcapi-common>

⁸ <http://docs.ogc.org/DRAFTS/20-004.html>

There are first activities within the INSPIRE community to develop a Good Practice for INSPIRE catalogue services based on the OGC API Records standard⁹.

2.1.2 OGC SensorThings API

Another important development at the OGC is the SensorThings API standard¹⁰ which specifies an interoperable way to encode and provide access to observation (data streams) generated by sensors. This standard was already adopted in 2016. Thus, the core of this specification was developed before the OGC API family of standards was in the focus of the OGC community. As a result, there are several differences between the SensorThings API and those standards belonging to the OGC API family of standards. While both approaches rely on REST and JSON as base concepts, the SensorThings API follows the principles of the OData standard¹¹. This results in several conceptual differences (OpenAPI vs. OData) so that the SensorThings API is not considered a part of the OGC API family of standards, but for the future at least a partial harmonisation with the OGC API standards is foreseen.

Besides common functionality to create, read, update, and delete sensor resources (e.g., data streams, observations, etc.), it also offers an optional support of the MQTT protocol¹² that allows a push-based transmission of sensor data (e.g., actively delivering new observations to subscribers as soon as they become available).

Since its adoption by the OGC, the SensorThings API specification has gained more and more acceptance. Thus, we can observe an increasing number of implementations of this standard. This has also resulted in an INSPIRE good practice document describing an approach for implementing an INSPIRE Download Service for observation data using the SensorThings API standard¹³.

For data.europa.eu, this opens up a new option to integrate further sources of real-time data in addition to the data streams offered via instances of the CEF/FIWARE Context Broker.

2.2 Open Data Directive, High-value datasets and INSPIRE

The European Directive on open data and the re-use of public sector information (Open Data Directive)¹⁴ is also known by its previous short name: PSI Directive. The new title “Open Data Directive” emphasises that public bodies are expected to publish data in *open* formats. The Original PSI Directive was passed in 2003, first amended in 2013 and again in 2019. The objective of the 2019 recast of the Directive is to strengthen the EU’s data-economy by increasing the amount of publicly funded data available for re-use.

The European Commission’s description on the legislation (Directorate-General for Communications Networks, Content and Technology (2021), Communications Networks, Content and Technology

⁹ <https://github.com/INSPIRE-MIF/gp-ogc-api-records>

¹⁰ <https://docs.ogc.org/is/18-088/18-088.html>

¹¹ https://www.oasis-open.org/committees/tc_home.php?wg_abbrev=odata

¹² <https://mqtt.org/>

¹³ <https://inspire.ec.europa.eu/good-practice/ogc-sensorthings-api-inspire-download-service>

¹⁴ <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1561563110433&uri=CELEX:32019L1024>

(2021): European legislation on open data¹⁵) states that once transposed by the Member States, the new rules will:

- “stimulate the publishing of dynamic data and the uptake of Application Programme Interfaces (APIs);
- limit the exceptions which currently allow public bodies to charge more than the marginal costs of dissemination for the re-use of their data;
- enlarge the scope of the Directive to:
 - Data held by public undertakings, under a specific set of rules. In principle, the Directive will only apply to data which the undertakings make available for re-use. Charges for the re-use of such data can be above marginal costs for dissemination;
 - Research data resulting from public funding – Member States will be asked to develop policies for open access to publicly funded research data. New rules will also facilitate the re-usability of research data that is already contained in open repositories.
- strengthen the transparency requirements for public–private agreements involving public sector information, avoiding exclusive arrangements.”

The Open Data Directive introduces the concept of “high-value datasets”: These datasets are meant to be used to create value-added services to benefit society, the environment, and the economy. High-value datasets shall be made available for re-use:

- with minimal legal restrictions
- free of charge
- in a machine-readable format
- as a bulk download (where relevant)
- via suitable APIs

The European Commission is currently working on an implementing act which will define a list of specific high-value datasets. The Open Data Directive lists 6 thematic categories and possible examples as shown in Table 1.

Table 1: High-value datasets (Source: Open Data Directive (Directive (EU) 2019/1024), No. 66)

Thematic Categories	Examples
Geospatial	<ul style="list-style-type: none"> • Postcodes • National and local maps

¹⁵ <https://digital-strategy.ec.europa.eu/en/policies/legislation-open-data>

Earth observation and environment	<ul style="list-style-type: none"> • Energy consumption • Satellite images
Meteorological	<ul style="list-style-type: none"> • In-situ data from instruments • Weather forecasts
Statistics	<ul style="list-style-type: none"> • Demographic indicators • Economic indicators
Companies and company ownership	<ul style="list-style-type: none"> • Business registers • Registration identifiers
Mobility	<ul style="list-style-type: none"> • Road signs • Inland waterways

As the Open Data Directive does not provide the full list of high-value datasets and the implementing act is not yet published, the following excerpt from a recent report is especially interesting:

Kotsev A. et al (2021): “INSPIRE - A Public Sector Contribution to the European Green Deal Data Space, A vision for the technological evolution of Europe’s Spatial Data Infrastructures for 2030¹⁶”, p. 60:

“At the time of finalising this report (August 2021), the Commission is working on an implementing act on high-value datasets (with adoption expected between the end of 2021 and beginning of 2022) that will lay down the full list of high-value datasets. The implementing act will rely heavily on the INSPIRE Directive, both in terms of the actual datasets and their modes of provision (data formats, metadata information, licensing, etc.) for the definition of high-value datasets in the thematic categories Geospatial, Earth observation and environment and Mobility. Some datasets already made available by Member States data providers under several INSPIRE data themes (from all INSPIRE Annexes) falling under the three abovementioned categories will be also part of the high-value datasets.”

INSPIRE refers to *Directive 2007/2/EC Infrastructure for Spatial Information in Europe*¹⁷ which was adopted in 2007. The purpose of INSPIRE is to support environmental protection policy by improving the availability and accessibility of relevant geodata. Geographic information is perceived to be the key

¹⁶ <https://publications.jrc.ec.europa.eu/repository/handle/JRC126319>

¹⁷ <http://eurlex.europa.eu/JOHtml.do?uri=OJ:L:2007:108:SOM:EN:HTML>

for good governance and decision making, so it needs to be readily and transparently available. As the impacts of pollution and other environmental issues do not stop at political borders, it makes sense that the effort is being made at the European level.

To support the INSPIRE Directive major effort is being made at the European level to harmonise and share data between administrations, and across borders. The INSPIRE Directive lists 34 data themes in its Annexes (see Table 2). Thus, geodata in scope of the directive are often referred to as “Annex themes”.

Table 2: List of INSPIRE data themes (Source: INSPIRE Directive (Directive (EU) 2007/2/EC)

Annex I	Annex II	Annex III
Coordinate reference systems	Elevation	Statistical units
Geographical grid systems	Land cover	Buildings
Geographical names	Orthoimagery	Soil
Administrative units	Geology	Land use
Addresses		Human health and safety
Cadastral parcels		Utility and Government services
Transport networks		Environmental monitoring facilities
Hydrography		Production and industrial facilities
Protected sites		Agricultural and aquaculture facilities
		Population distribution – demography
		Area management/restriction/regulation zones and reporting units
		Natural risk zones
		Atmospheric conditions
		Meteorological geographical features
		Oceanographic geographical features
		Sea regions
		Bio-geographical regions
		Habitats and biotopes

Species distribution

Energy resources

Mineral resources

In their article on the The State of Open Data¹⁸, Davies et al (2019) note that while efforts on open geospatial infrastructures pre-date the advent of open data *“there are relatively weak links between the open geospatial and other open data communities. Stronger links could build critical capacity for spatial analysis within open data communities.”*

Data.europa.eu offers the opportunity to strengthen the links between open data and geospatial data communities and promote the use of geospatial information within open data contexts.

Data.europa.eu harvests public sector data from open data portals and geoportals on the EU and national level but also from international, regional, local and domain-specific portals. Many of the geoportals include data published under the INSPIRE Directive, so a high overlap can be expected for the high-value datasets thematic categories “Geospatial”, “Earth observation and Environment” and “Mobility”. Once the implementing act on high-value datasets is published, it will be interesting to find ways to showcase the relevant geodata already accessible via data.europa.eu. For the future it can be expected that more data will be published as more data is now within the scope of the Open Data Directive and the publishing of dynamic data and geodata via APIs is encouraged.

¹⁸ <https://library.oapen.org/handle/20.500.12657/24884>

3 Conclusions and Key Points of Attention

As a result of our analysis, we see especially the following potential work items that would be useful for further advancing data.europa.eu:

1. Investigate the integration of OGC API Features endpoints as part of the data.europa.eu geo-visualisation

Next steps and timeframe:

- When?
 - During 2022
- Topics to investigate:
 - How are OGC API Features endpoints currently described in geo-metadata harvested for data.europa.eu?
 - How can the geospatial visualisation component display the content offered by OGC API Features endpoints in a user friendly manner?

2. Investigate the inclusion of the OGC API standards and the SensorThings API and how they can be represented as dedicated service types on data.europa.eu

- When?
 - During 2022
- Topics to investigate:
 - In which way shall content offered by SensorThings API instances be made discoverable via data.europa.eu?
 - Shall it be possible to discover individual data streams or is it better to just discover the server instances as a whole?
 - How can the metadata describing a SensorThings API instance be mapped to DCAT-API?

3. Investigate how metadata from OGC API Records endpoints can be efficiently harvested

Next steps and timeframe:

- When?
 - After OGC API Records has been published (it currently has a draft status)
- Topics to investigate:
 - When are the first OGC API Records catalogues available for harvesting?
 - Will INSPIRE recommend Member States to switch from CSW to OGC API Records?
 - Are there benefits in adding OGC API Records to the supported endpoints for the geoharvester?

4. Advance the geo-visualisation component in order to support the OGC SensorThings API standards as a further source of real-time data

- When?
 - After an approach is available how content of SensorThings API instance shall be described (see above)
- Topics to investigate:

- How can the preview of SensorThings API instances be supported in the geospatial data visualisation?
- Which data should be visualised (e.g., sensor locations, latest measurements, timeseries of historical measurements)?
- Are there conceptual changes necessary in order to accommodate the preview of the SensorThings API (e.g., new workflows for data selection)?

5. Investigate ways to support finding and accessing high-value datasets

Next steps and timeframe:

- When?
 - Implementing act on high-value datasets is passed
 - Member States have started publishing high-value datasets (or declared already published geodata as high-value datasets)
 - INSPIRE geoportal has launched new feature to browse/view HVD
- Topics to investigate:
 - How do the Member States publish and describe high-value datasets?
 - What insights does the planned new feature of the INSPIRE geoportal¹⁹ to browse/view geospatial HVDs offer to users? How many datasets can be discovered in this way? Can this approach help users locate geospatial HVD from authoritative governmental sources?
 - What are user expectations for data.europa.eu in regards to finding and accessing HVDs?
 - Are there specific user expectations for data.europa.eu in regards to finding and accessing *geospatial* HVDs?
 - Is there a need for data.europa.eu academy training in regards to HVD, e.g. explaining the relationship between INSPIRE annex themes (see Table 2) and HVD (see Table 1)?

¹⁹ <https://inspire-geoportal.ec.europa.eu/>

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