

Geospatial Trends 2022

*Opportunities for data.europa.eu from emerging trends in the
geospatial community*

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 reuse of public sector information. The portal provides access to open data from international, EU, national and regional sources. For the most part this is done by collecting the metadata of public data made available across Europe in a process called ‘harvesting’. Metadata is harvested from both open data portals and geodata portals and is made available on data.europa.eu as a single point of access.

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. Facilitating the discovery of and access to open geospatial data sources is an important feature of data.europa.eu.

In her article ‘Geospatial’⁽¹⁾, Sieber (2019) notes that, while efforts relating to 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 to promote the use of geospatial information within open data contexts.

As part of the data.europa.eu mission to support European countries in increasing their open data maturity and promoting reuse, 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 to 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 recognisable tendency or direction of development, or, to quote the *Cambridge Dictionary*, a ‘general development or change in a situation or in the way that people are behaving’⁽²⁾.

Two topics were chosen to be discussed in this report as they seem especially relevant to data delivery and discovery, and applicable to data.europa.eu.

The 2022 data.europa.eu report on opportunities for data.europa.eu from emerging trends in the geospatial community will focus on two trends that affect the European geospatial community:

- (1) modernising Inspire – moving towards open data (see Section 2.1);
- (2) the role of geospatial information for smart cities (see Section 2.2).

⁽¹⁾ Davies, T., Walker, S., Rubinstein, M., Perini, F. (2019): The State of Open Data. Histories and Horizons, <https://library.oapen.org/handle/20.500.12657/24884>

⁽²⁾ Cambridge Dictionary <https://dictionary.cambridge.org/dictionary/english/trend>

2.1. Modernising Inspire – moving towards open data

The goal of Directive 2007/2/EC (the Inspire directive) ⁽³⁾ is to support environmental protection policy by improving the availability and accessibility of relevant geodata. Geographic information is perceived to be the key to good governance and decision-making, so it needs to be readily and transparently available. As the impact of pollution and other environmental issues does not stop at political borders, it is apparent that an effort in this regard is being made at the EU level. The Inspire directive was adopted in 2007 and was implemented following a road map that spanned 15 years until the final deadline in December 2021.

In 2022 the European Commission published an evaluation of the Inspire directive, which can provide some insight on how Inspire might be adapted in the future. The evaluation summary states that Inspire has improved efficiency by creating a framework for geospatial data sharing, making the data findable, accessible, interoperable, and reusable (FAIR). On a critical note, the report addresses ‘the INSPIRE Directive’s technical over-specification’ which ‘renders the legal framework less fit for the future in the light of technological evolution’ and names ‘simplification potential of the implementation in terms of addressing the too detailed interoperability requirements’. The Inspire directive is expected to support the implementation of Directive 2003/4/EC ⁽⁴⁾ and Directive (EU) 2019/1024 (the open data directive) ⁽⁵⁾.

The European Commission staff working document ‘Executive summary of the evaluation of Directive 2007/2/EC establishing an infrastructure for spatial information in the European Community (Inspire)’ ⁽⁶⁾ stresses the value of Inspire:

Although the Directive was designed as an environmental policy instrument, its implementation has demonstrated its value for implementing other policies, even where there is no legal requirement. This is for the following reasons:

- *The principles and protocols on which INSPIRE is built are based on internationally recognised standards for disseminating geospatial data.*
- *The quantity of data becomes ever more abundant, which provides significant opportunities for better policies, implementation, environmental protection, and commercial applications.*
- *Today’s societal challenges call for cross-cutting interventions and many EU policies are so interwoven that new policies inevitably must aim to achieve multiple objectives, notably the European Green Deal. This calls for better data sharing to underpin better policy at less cost.*
- *The currency of the modern data economy is data and, as highlighted in the EU digital strategy, INSPIRE is a front-runner instrument.*

⁽³⁾ INSPIRE Directive <http://eurlex.europa.eu/JOHtml.do?uri=OJ:L:2007:108:SOM:EN:HTML>

⁽⁶⁾ Sharing geospatial data on the environment – evaluation (INSPIRE Directive) <https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12427-Sharing-geospatial-data-on-the-environment-evaluation-INSPIRE-Directive-en>

There is an overlap between the scope of the Inspire directive and that of the open data directive.

In terms of the interplay with the Inspire directive, the new open data directive makes several references to Inspire to clarify the interactions between the directives. The objective of the 2019 recasting of the open data directive was to strengthen the EU's data economy by increasing the amount of publicly funded data available for reuse. The recasting introduced the concept of 'high-value datasets' (HVDs). These datasets are meant to be used to create value-added services to benefit society, the environment, and the economy. HVDs must be made available for reuse:

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

The European Commission has produced a draft implementing regulation laying down a list of specific HVDs and the arrangements for their publication and reuse ⁽⁷⁾.

In its annexes, the Inspire directive lists 34 data themes that fall within its scope. These are often referred to as 'Inspire annex themes'. Annex I to the open data directive lists six thematic categories. The draft implementing regulation for the HVDs references some Inspire annex themes in three of the six thematic categories. Table 1 gives an overview of which Inspire data themes are considered HVDs.

Table 1: List of Inspire data themes referenced in the draft implementation regulation for HVDs

Inspire data theme	Referenced in the draft implementing regulation laying down a list of specific HVDs and the arrangements for their publication and reuse
Inspire Annex I	
Coordinate reference systems	
Geographical grid systems	
Geographical names	Within the scope of 'Geospatial'
Administrative units	Within the scope of 'Geospatial'
Addresses	Within the scope of 'Geospatial'
Cadastral parcels	Within the scope of 'Geospatial'
Transport networks	Within the scope of 'Mobility'
Hydrography	
Protected sites	Within the scope of 'Earth observation and environment'

⁽⁷⁾ Draft implementing regulation laying down a list of specific high-value datasets and the arrangements for their publication and re-use, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=pi_com%3AAres%282022%293905386

Inspire data theme	Referenced in the draft implementing regulation laying down a list of specific HVDs and the arrangements for their publication and reuse
Inspire Annex II	
Elevation	Within the scope of 'Earth observation and environment'
Land cover	Within the scope of 'Earth observation and environment'
Orthoimagery	Within the scope of 'Earth observation and environment'
Geology	Within the scope of 'Earth observation and environment'
Inspire Annex III	
Statistical units	
Buildings	Within the scope of 'Geospatial'
Soil	Within the scope of 'Earth observation and environment'
Land use	Within the scope of 'Earth observation and environment'
Human health and safety	
Utility and government services	
Environmental monitoring facilities	Within the scope of 'Earth observation and environment'
Production and industrial facilities	Within the scope of 'Earth observation and environment'
Agricultural and aquaculture facilities	
Population distribution – demography	
Area management/restriction/regulation zones and reporting units	Within the scope of 'Earth observation and environment'
Natural risk zones	Within the scope of 'Earth observation and environment'
Atmospheric conditions	
Meteorological geographical features	
Oceanographic geographical features	Within the scope of 'Earth observation and environment'
Sea regions	Within the scope of 'Earth observation and environment'
Bio-geographical regions	Within the scope of 'Earth observation and environment'
Habitats and biotopes	Within the scope of 'Earth observation and environment'
Species distribution	Within the scope of 'Earth observation and environment'

Inspire data theme	Referenced in the draft implementing regulation laying down a list of specific HVDs and the arrangements for their publication and reuse
Energy resources	Within the scope of 'Earth observation and environment'
Mineral resource	Within the scope of 'Earth observation and environment'

HVDs were addressed in *Geospatial Trends 2021* ⁽⁸⁾. Data.europa.eu harvests metadata on public sector data from open data catalogues and geocatalogues. As many of the geocatalogues include data published under the Inspire directive, a high degree of overlap can be expected for the HVD thematic categories 'Geospatial', 'Earth observation and environment' and 'Mobility'. Once the implementing act on HVDs is published, it will be interesting to find ways to showcase the relevant geodata already accessible via data.europa.eu. In the future, it can be expected that more data will be published as it is now within the scope of the open data directive, and the publishing of dynamic data and geodata via APIs is encouraged. Investigating ways to support finding and accessing HVDs was listed as key point of attention (see Section 3.4). As the implementing regulation had not been passed at the time of writing (October 2022), this should be revisited in 2023.

2.2. Smart cities and geoinformation

The concept of 'smart cities' refers to the idea that new (digital) technologies will help to improve life in cities and the management of cities based on the improved availability of up-to-date information. For example, the European Commission provides the following definition of smart cities on a dedicated website ⁽⁹⁾:

A smart city is a place where traditional networks and services are made more efficient with the use of digital solutions for the benefit of its inhabitants and business. A smart city goes beyond the use of digital technologies for better resource use and less emissions. It means smarter urban transport networks, upgraded water supply and waste disposal facilities and more efficient ways to light and heat buildings. It also means a more interactive and responsive city administration, safer public spaces and meeting the needs of an ageing population.

Over the past several years, the development of smart city environments has gained more and more momentum. Due to the high strategic value of this topic, there are several EU, national and regional initiatives to support the development of smart city infrastructure. Besides the technical aspects, such as building better monitoring networks or setting up new sensor technologies, these initiatives involve social, economic, and administrative aspects.

From the perspective of data.europa.eu, the increasing availability of data resulting from new smart city infrastructure is an important trend. As comprehensive up-to-date data is an important foundation

⁽⁸⁾ Jirka, S. and Kügeler, A. (2021), *Geospatial Trends 2021: Opportunities for data.europa.eu from emerging trends in the geospatial community*, https://data.europa.eu/sites/default/files/report/Geospatial_Trends_2021_1.pdf.

⁽⁹⁾ European Commission, 'Smart cities', https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en.

for better decision-making within cities, smart city projects typically strengthen the collection and sharing of new types of data streams. At the same time, the continuous advancement of internet-of-things technologies is contributing to simplifying the data collection process. Moreover, the geospatial reference is usually an essential part of the collected data. Important examples of data relevant to smart city projects include:

- geospatial base data (e.g. background maps),
- traffic (car counts, person counts, traffic lights, parking spaces, bike sharing, etc.),
- public transportation (real-time schedules, delays, and disturbances, etc.),
- environmental conditions,
- lighting,
- utility network data,
- 3D models.

From a legal perspective, many types of data that come under the HVDs are closely related to smart cities (e.g. mobility data, real-time environmental data, any kind of dynamic spatial data).

Often, the collected datasets are published as open data to increase their reuse and to enable new business models that take advantage of these data resources. Consequently, this trend is an important opportunity for data.europa.eu. Data.europa.eu is already helping users discover different types of smart city related information:

- background documents on smart -city activities,
- historical data (e.g. traffic counts from past years),
- base data (e.g. smart city infrastructure such as sensor locations),
- real-time data (e.g. live information on public transportation or the availability of parking spaces).

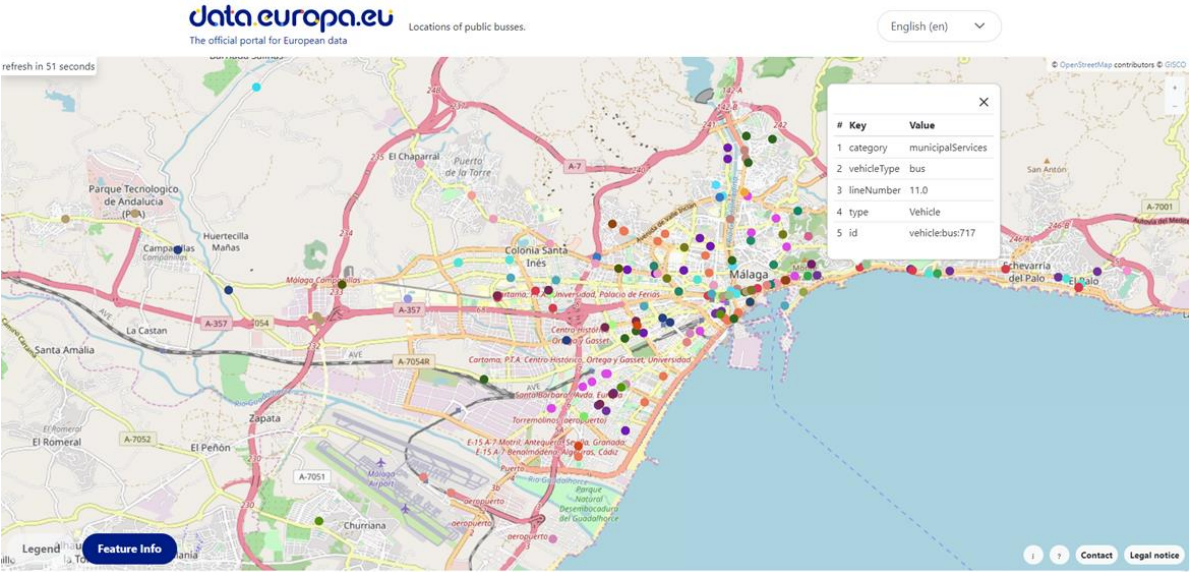


Figure 1: Preview of live public transportation data as part of data.europa.eu (here: bus locations within the city of Malaga)

Based on the current situation and expected future developments, we see the following aspects as opportunities for data.europa.eu.

Smart -city initiatives will, in particular, strengthen the availability of real-time information. We therefore see this as a valuable type of information resource that could deliver significant added value for data users. For this reason, data.europa.eu is already paying close attention to the integration of real-time data sources (Jirka and Kügeler, 2022).

Another aspect that should be considered is the involvement of citizen science activities in smart city contexts. This refers to new data generated by citizens, either by contributing their own observations or by operating their own sensing devices (e.g. for noise measurements, low-cost air-quality observations, traffic information). Also in this context, there is the potential for further data sources that might be of interest to data.europa.eu.

However, to increase the discoverability of smart city resources via data.europa.eu, we see several challenges that need to be addressed.

With regard to real-time data, we recommend first identifying relevant standards for interfaces and encoding. In addition, further consideration should be given to ways to provide metadata for such real-time data sources. For example, there is a need to provide guidance on how to describe resources such as data streams or brokers making real-time data streams available. The descriptions of these resources need to be mapped to the Data Catalogue (DCAT) Application profile for data portals in Europe (DCAT-AP). It is then necessary to find a suitable abstraction level to enable useful discovery functionality (e.g. the granularity of the real-time resources requires a trade-off between a very detailed description of each data stream, which would lead to very large sets of results, and rather general aggregations of multiple data streams into larger datasets).

In addition to this technical input, outreach activities involving internet-of-things communities are advisable to motivate further providers to share their data. This should be combined with good-practice guidance and success stories that could serve as blueprints for the publication of smart city data.

Finally, the preview functionality of data.europa.eu should be extended to enable better visualisation of the highly dynamic datasets that are typical for smart city scenarios.

2.3. Webinar on geospatial trends

On 27 October 2022 a webinar was held on emerging trends in the geospatial community ⁽¹⁰⁾. The goal was to gather input from the participants on which trends, standards or ideas could be relevant for data.europa.eu. There were 209 registered participants in total, 96 of whom were from national/regional/local public institutions, 48 from EU entities, 31 from the private sector, 16 from academia, 7 from NGOs and international organisations, and 11 others.

At the beginning of the webinar, a brainstorming session on current trends regarding geospatial topics was conducted. The participants were asked what current trends regarding geospatial topics came to mind, and what trends might affect the way we use geospatial data.

⁽¹⁰⁾ European Commission, data.europa.eu, 'Trends in geospatial data' webinar, <https://data.europa.eu/en/academy/trends-geospatial-data>.

Figure 2 depicts a word cloud of the terms entered, where the size of the word is proportional to how frequently it was mentioned by the participants.

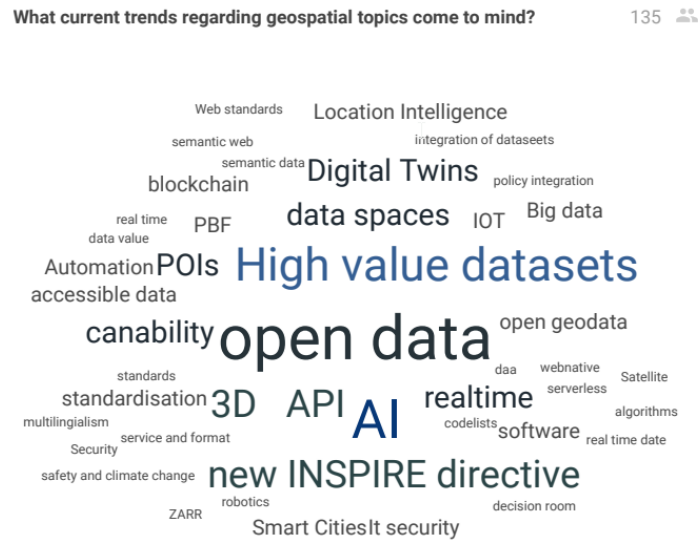


Figure 2: Trends named by participants in webinar on 27 October 2022

While not a representative survey, these insights may be useful in providing input when choosing trends to focus on in next year’s report.

After an introduction to data.europa.eu, short talks were given on two chosen topics that may be of interest for the future of data.europa.eu:

- modernising Inspire – moving towards open data (see Section 2.1);
- the role of geospatial information for smart cities (see Section 2.2).

Lastly, an online activity was carried out to gather participant’s views on what opportunities for data.europa.eu might arise from these trends and how data.europa.eu might benefit from and support new ways of sharing geospatial data. The input included not only ideas directly connected to the topics presented, but broader questions on such topics as strategic positioning. It would be good to know the place of data.europa.eu in the future and how the European data portal will be positioned in the upcoming data space architecture. Ideas for advancing data.europa.eu include:

- providing support for Open Geospatial Consortium (OGC) APIs;
- making the map interface more prominent;
- extending the map interface for data searches;
- extending functionality for navigation, filtering and clustering to make sense of the data;
- developing of a data/app store that combines data, intermediaries and derived data products with end-user categorisation to facilitate reuse;
- adding quality-level badges to datasets, similar to Wikipedia badges;
- adding DQV (Data Quality Vocabularies) as an extension to DCAT;
- including the content of the Lineage 19115 field in the DCAT description field.

Some interesting outreach activities were suggested, such as providing support to cities in order to collect, share and standardise geospatial data or promote geospatial data in thematic communities that would benefit from its use, for example spatial planning and architects. It was proposed that data.europa.eu could be used as a platform to emphasise the importance of location data in reaching the goals of the European Green Deal ⁽¹¹⁾, for example by providing use cases for implantation, monitoring and reporting. One participant hoped for more reuse and interesting reuse cases with an impact on our environment, economy, and society.

The participants provided a number of application scenarios for data found on data.europa.eu, such as enabling a quicker and more coordinated response to emergencies, helping cities adapt to climate change (e.g. heatwaves, large rainstorms) or raising awareness of geospatial intelligence for crisis management (e.g. climate, conflicts, energy), which could boost the willingness to share data.

⁽¹¹⁾ European Commission, 'A European Green Deal', https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en.

3. Key points for attention from the 2021 report

As a result of our analysis from 2021 ⁽¹²⁾ we had listed some potential work items that would be useful in further advancing data.europa.eu. These key points for attention are described in this section.

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

From <i>Geospatial Trends 2021</i>
Next steps and timeframe: <ul style="list-style-type: none">• When?<ul style="list-style-type: none">○ During 2022• Topics to investigate:<ul style="list-style-type: none">○ 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?

How are OGC API Features endpoints currently described in geo-metadata harvested for data.europa.eu?

This question was considered by searching for ‘OGC API Features’ on data.europa.eu. At the time this report was written (October 2022) the query for ‘OGC API Features’ ⁽¹³⁾ produced 1 798 results. The results originate from only a small number of catalogues from Germany, Belgium, Austria, Poland, Italy and the United Kingdom (see Figure 3).

Catalogues ©	
GDI-DE	1 048
GovData	625
data.gov.be	109
inspire.gv.at	8
Portal Geostatystyczny	5
data.gov.uk	1
opendataportal.at	1
Italian Catalogue of metadata fo...	1

Figure 3: Number of results from catalogues for the query ‘OGC API Features’ on data.europa.eu (screenshot dated 24 October 2022)

⁽¹²⁾ Jirka, S. and Kügeler, A. (2021), *Geospatial Trends 2021: Opportunities for data.europa.eu from emerging trends in the geospatial community*, https://data.europa.eu/sites/default/files/report/Geospatial_Trends_2021_1.pdf.

⁽¹³⁾ Search on data.europa.eu, <https://data.europa.eu/data/datasets?query=%22OGC%20API%20Features%22&locale=en&page=1>.

Examples of the metadata from the catalogues were then investigated to determine how the OGC API Features endpoints are currently described in the original geo-metadata from the geocatalogues.

Although all the metadata examined uses the ISO 19139 metadata standard, the OGC API Features endpoints are described in multiple ways. As there seems to be no consensus on a 'correct' way of describing API Features endpoints, all of the approaches seem valid. The metadata sets from Germany and Poland describe the endpoints as a service, while the metadata sets from the other geocatalogues describe datasets. The URLs to the OGC API endpoints are also declared in different XML elements and ways.

The heterogeneous form of description in the originating geocatalogues would currently make it difficult to detect the OGC API Features and map it as a distribution in DCAT-AP. For this reason, it would be prudent to wait until more metadata describing this kind of data becomes available, while also carrying out more research into whether there are any efforts relating to harmonising the way OGC API Features are described.

How can the geospatial visualisation component display the content offered by OGC API Features endpoints in a user-friendly manner?

The availability of a stable way to provide metadata about OGC API Features endpoints is a prerequisite. Depending on the granularity of the metadata provided, different approaches to visualisation would be useful (e.g. an overview of subsets of the data (paging) versus aggregated overviews to avoid downloading the complete feature data versus a preview of the actual feature data). Thus, this work will be further advanced after the necessary guidance on metadata for the OGC API Features becomes available.

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

From *Geospatial Trends 2021*

- 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?

How will content offered by SensorThings API instances be made discoverable via data.europa.eu?

The work on this topic is ongoing. Although search requests for ‘SensorThings’ on data.europa.eu ⁽¹⁴⁾ lead to significant numbers of results, only a very small number of them lead to actual implementations of the OGC SensorThings API specification. Furthermore, the discovery of concrete data offered by these servers is not always possible, as a general description of a server is not yet sufficient to determine whether the data offered by a server is suitable for the needs of a user.

Consequently, an approach is required that helps to describe the contents offered by an OGC SensorThings API server. To achieve this goal, the first step is to develop best-practice guidance on the level of granularity to be used for describing SensorThings API resources (see below).

Will it be possible to discover individual data streams or is it better to discover the server instances as a whole?

To answer this question, further work is necessary. After observing typical implementation strategies in practice, three different approaches can be seen.

- **Describing SensorThings API instances as a whole.** In this case, a rather general description of the contents of a SensorThings API server can be provided, which might be automatically harvested. This may include important keywords characterising the data offered and a geographical bounding box describing the spatial extent covered by the server. While this approach is rather lightweight, it has the drawback that the discovery of specific datasets offered by the server is not well supported. In this case, users would have to connect to a potentially interesting server to further determine its data offerings.
- **Describing individual data streams offered by an OGC SensorThings API server.** This approach would offer the highest level of detail, and it would be possible to automatically harvest such metadata. However, this could also hugely increase the number of metadata sets (e.g. considering a use case in which thousands of sensors might be deployed).
- **Describing subsets of data of a SensorThings API server as aggregated datasets.** This approach can be seen as a hybrid approach. In this case, the aggregated data could be identified by a given set of filters encoded in a SensorThings API GET request to download data. This approach offers the possibility to define logical datasets, and at the same time avoids unnecessarily high numbers of metadata records. However, this approach has the drawback that human interaction is necessary to define suitable aggregated datasets. This additional work could become a limiting factor in motivating data providers to share their SensorThings API servers.

As all of these solutions have their specific drawbacks, we recommend following up further on this topic and trying to involve data providers and users in order to gather feedback on preferences for SensorThings API metadata.

How can the metadata describing a SensorThings API instance be mapped to DCAT-API?

The answer to this question requires a decision on the previous two questions. When these challenges have been addressed to a sufficient extent, mapping to DCAT-API will be the next work item.

⁽¹⁴⁾ Search for ‘SensorThings’ on data.europa.eu, <https://data.europa.eu/data/datasets?query=SensorThings&locale=en>.

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

From *Geospatial Trends 2021*

- 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)?

At the time of writing, work was still ongoing on how to describe SensorThings API instances in the best possible manner. Because the provision of a stable metadata model for SensorThings API instances is critical to further developing a suitable data preview mechanism, work on this set of questions will start once corresponding best-practice guidance is available.

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

From *Geospatial Trends 2021*

Next steps and timeframe:

- When?
 - Implementing act on HVDs is passed
 - Member States have started publishing HVDs (or declared already published geodata as HVDs)
 - Inspire geoportal has launched new feature to browse/view HVD
- Topics to investigate.
 - How do the Member States publish and describe HVDs?
 - What insights does the planned new feature of the Inspire geoportal ⁽¹⁵⁾ 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 and HVD?

⁽¹⁵⁾ Inspire Geoportal, <https://inspire-geoportal.ec.europa.eu/>.

At the time of writing, the implementing regulation laying down a list of specific HVDs and the arrangements for their publication and reuse has not yet been published. A draft version is available ⁽¹⁶⁾ ⁽¹⁷⁾ (see Section 2.1)

As the investigation should be carried out after the implementing regulation has been passed and Member States have started publishing HVDs, we will put this on the agenda for 2023.

During the webinar on geospatial trends (see Section 2.3) HVDs were mentioned several times, and it was suggested that data.europa.eu should play a role in educating stakeholders about HVDs.

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

From *Geospatial Trends 2021*

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?

At the time of writing, the OGC API Records specification ⁽¹⁸⁾ was still in draft form. A currently empty repository ⁽¹⁹⁾ has been created as a discussion space on possible good practices for Inspire catalogue services based on OGC API Records.

As the investigation should be carried out after the OGC API Records specification has been published, we will put this on the agenda for 2023.

⁽¹⁶⁾ Open data – availability of public datasets, public consultation, https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12111-Open-data-availability-of-public-datasets_en.

⁽¹⁷⁾ Draft implementing regulation laying down a list of specific high-value datasets and the arrangements for their publication and re-use, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=pi_com%3AAres%282022%293905386.

⁽¹⁸⁾ Open Geospatial Consortium, 'OGC API – Records', <https://ogcapi.ogc.org/records/>.

⁽¹⁹⁾ 'Discussion space on a possible Good Practice for Inspire catalogue services based on OGC API – Records' <https://github.com/INSPIRE-MIF/gp-ogc-api-records>.

4. Conclusions and key points

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

1. Promote OGC API Features endpoints and their homogeneous description in geocatalogues using ISO metadata

Next steps and time frame.

- When?
 - During 2023.
- Topics to investigate.
 - Are there any efforts to harmonise the way OGC API Features are described in ISO geo-metadata or GeoDCAT-AP?
 - How can OGC API Features endpoints described in geo-metadata be identified in the geoharvesting process?
 - How can OGC API Features endpoints be displayed as a distribution?
 - What would be a user-friendly way to filter for data provided via OGC API Features on data.europa.eu?
 - After a way to identify metadata on OGC API Feature endpoints has been established, investigate how a first version of an enhanced version of the Geo Viewer can be designed.

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

- When?
 - During 2023.
- Topics to investigate.
 - How will content offered by SensorThings API instances be made discoverable via data.europa.eu?
 - Will it be possible to discover individual data streams or is it better to just discover the server instances as a whole? Are there hybrid approaches that offer a suitable trade-off between both ideas?
 - How can the metadata-harvesting process be designed in an automated way to keep the workload for human administrators as low as possible?
 - How can the metadata describing a SensorThings API instance be mapped to DCAT-AP?

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

- When?
 - Once a way to describe the content of SensorThings API instances is established (see above).
- Topics to investigate.
 - How can the preview of SensorThings API instances be supported in the geospatial data visualisation?
 - What data should be visualised (e.g. sensor locations, latest measurements, Time series of historical measurements)?

- Are conceptual changes necessary to accommodate the preview of the SensorThings API (e.g. new workflows for data selection)?

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

Next steps and time frame.

- When?
 - Once the implementing act on HVDs has been passed.
 - After Member States have started publishing HVDs (or have declared that they have already published geodata as HVDs).
 - When the Inspire geoportal has launched the new feature to browse/view HVDs.
- Topics to investigate.
 - How do the Member States publish and describe HVDs?
 - What insights does the planned new feature of the Inspire geoportal ⁽²⁰⁾ for browsing/viewing geospatial HVDs offer to users? How many datasets can be discovered in this way? Can this approach help users locate geospatial HVDs from authoritative governmental sources?
 - What are users' expectations for data.europa.eu in regard to finding and accessing HVDs?
 - Are there specific user expectations for data.europa.eu in regard to finding and accessing geospatial HVDs?
 - Is there a need for data.europa.eu academy training in regard to HVDs, for example explaining the relationship between Inspire annex themes and HVDs (see Table 1)?

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

Next steps and time frame.

- When?
 - After OGC API Records has been published (it is currently in draft form).
- Topics to investigate.
 - When will the first OGC API Records catalogues be available for harvesting?
 - Will Inspire recommend that Member States switch from CSW to OGC API Records?
 - Are there benefits in adding OGC API Records to the endpoints supported by the geoharvester?

⁽²⁰⁾ Inspire Geoportal, <https://inspire-geoportal.ec.europa.eu/>.

6. Investigate – implications from smart city initiatives

- When?
 - During 2023.
- Topics to investigate.
 - What are the relevant types of data sources offering smart city data?
 - What are suitable ways to provide metadata about smart city data resources?
 - How can smart city initiatives be motivated to share their data as open data and to provide sufficient metadata to make it discoverable?

This report has been compiled to investigate and start a discussion on how current geospatial trends might affect user expectations for data.europa.eu and to find opportunities that arise from them. The ideas from the *Geospatial Trends 2021* report ⁽²¹⁾ were discussed against the background of current developments. All of them remain open to be revisited at a later date, for example when the relevant legislation has been passed or standards have been adopted. In addition to this, new key points of attention to follow up over the next years were identified. These will be addressed in next year's report on geospatial trends.

Geospatial data is expected to play a key role in tackling modern -day challenges such as achieving the aims of the European Green Deal. Technological advances and societal transformations are constantly changing the way we work with data. This change of pace can bring unprecedented opportunities, and can also be viewed as an invitation to improve data.europa.eu.

⁽²¹⁾ Jirka, S. and Kügeler, A. (2021), *Geospatial Trends 2021: Opportunities for data.europa.eu from emerging trends in the geospatial community*, https://data.europa.eu/sites/default/files/report/Geospatial_Trends_2021_1.pdf.

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