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INSPIRE Community Forum on Environmental Monitoring & Observations Phase 2 - 2020 activity report (Deliverable – D3)

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INSPIRE Community Forum on Environmental Monitoring & Observations	p. 3 of 16
Report (Phase 2 – D3 - 2020)	2020-12-29

1. STATE OF PLAY IN THE THEMATIC DOMAIN

(Summary of the thematic domain activity related to the implementation and use of INSPIRE)

1.1. Overview / list of relevant EU Projects/technology/SW activities (title, short description, URL link)

1.1.1. API4INSPIRE

The API4INSPIRE project has been of special interest to the EF and O&M communities, as in addition to evaluating the potential of the newly defined OGC API for use within the INSPIRE domain, this project includes SensorThings API in this evaluation. This project is making good progress despite issues due to cancelled events, and will be shifting its dissemination activities into the virtual space. Tutorials for both OGC API (via GeoServer) and SensorThings API (via FROST) have been made available via the project site:

<https://github.com/DataCoveEU/API4INSPIRE>

In addition, various demonstration endpoints have been deployed and made openly available for experimentation by interested users, e.g.:

<https://datacoveeu.github.io/API4INSPIRE/datanests/franco-germanic-flow.html>

1.1.2. SensorThings API INSPIRE Good Practice

Based on the data mapping in the geosciences article “Extending INSPIRE to the Internet of Things through SensorThings API” - <https://doi.org/10.3390/geosciences8060221>, and the ongoing work in the API4INSPIRE Project, OGC SensorThings API has now been confirmed as an INSPIRE Download Service:

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

1.1.3. SensorThings API Ad-Hocs

Within the API4INSPIRE Project, we experimented with various usages of the SensorThings API beyond the originally foreseen data sources. In addition to more traditional data sources such as the European air quality data, we also experimented with data from other domains such as demography and Covid-19 case data as described in the sections below.

1.1.3.1. Ad-Hoc Air-Quality API

Illustrating the power of APIs for rapid provision of timely data access, the API4INSPIRE project spun off this activity based on current events. The initial trigger pertained to news reports on the influence of Corona induced lockdowns around the world on air quality. In a first step, the Austrian INSPIRE air quality were harvested, the data transformed and reprovided via SensorThings API for easier access and integration into applications. Based on the feedback received, this activity was extended to other European MS by accessing near-real-time data made available via the EEA. This activity highlighted the power of standardized data, as such an ad-hoc activity would not have been possible without well defined data models in place.

More information:

<https://www.linkedin.com/pulse/ad-hoc-austrian-air-quality-api-kathi-schleidt/>

1.1.3.2. Covid Things

A further interesting activity to emerge in the last months has been a dedicated SensorThings API endpoint providing up-to-date data on the current Covid-19 epidemic created by the University of Applied Sciences Stuttgart. Data is regularly harvested from various sources, foremost the Johns Hopkins Coronavirus Resource Center, Robert Koch Institute and Worldometers.info. In addition, a dashboard has been created to allow users to explore and visualize the available data.

More information:

<http://193.196.138.56:8080/STACOVID/>

A further implementation of a SensorThings API based endpoint for Covid-19 data has emerged from the GO-PEG project, providing detailed data from the Italian civil protection in real time:

<https://demography.k8s.ilt-dmz.iosb.fraunhofer.de/v1.1>

1.1.3.3. DemographyThings

Based on the insight that demography data is structurally quite similar to environmental monitoring data as well as the requirement for demography data to put the primary Covid-19 case numbers into context, we started experimenting with the usage of SensorThings API for demography data. In our first prototype, we provide population metrics harvested from Eurostat for NUTS regions on all levels from NUTS 0 to NUTS 3:

<https://demography.k8s.ilt-dmz.iosb.fraunhofer.de/v1.1>

Based on this success, we then went on to investigate the applicability of SensorThings API for the provision of gridded demography data. To this purpose, we have reprovided data from the Polish Statistical Agency on demography on the European 1km Grid:

<https://service.datacove.eu/DemographyThings/v1.1>

1.1.4. O&M Standard Update

The OGC has reviewed the current O&M 2.0 standard, and created an updated version 3.0 that is currently out for review. This work is being done jointly with ISO, and will lead to an update of ISO 19156. While substantial modifications and extensions have been performed, the standard is geared to be backwards compatible to the 2.0 version of the standard. Once this work has been finalized, the O&M based INSPIRE specifications should be revisited.

1.1.5. STAM – SensorThings API Mapper

In order to simplify uptake of SensorThings API based data, we have developed a library allowing for simple integration of SensorThings API with both Leaflet and Open Layers for rapid development of map-based viewers. STAM allows the user a wide range of configuration options, while providing default settings for all values.

STAM is available from the following repository:

<https://github.com/DataCoveEU/STAM>

1.2. Overview / list of selected good / highly visited / highly replied Forum contributions (your short description + link to the Forum content)

1.2.1. Validation Issues [250 Views]

As the deadlines for finalization of INSPIRE services draw close, more focus is being placed on the correct validation of provided datasets and service endpoints. This in turn serves to highlight various points of confusion pertaining to the requirements. In some cases, MS are still working with the 3.0 version of the schemas instead of the updated versions under 4.0, that in turn leads to issues with these old schema files. In addition, it shows that various software systems still have issues pertaining to the correct provision of data utilizing the INSPIRE data models

<https://inspire.ec.europa.eu/forum/discussion/view/264717/inspire-validator-error-one-of-httpwwwopengisnetgml32abstractfeature-is-expected>

<https://inspire.ec.europa.eu/forum/discussion/view/264607/schema-ef-inspire-validator-error-cannot-find-the-declaration-of-element-gmlfeaturecollection>

1.2.2. Theme vs. General Metadata Requirements [417 views]

The question was if metadata attributes not specifically mentioned within the thematic data specification are required in the dataset metadata, specific example pertained to the language of the meta-record. It was clarified that while the data specifications provide theme specific additions to the general dataset metadata, the general metadata requirements are valid regardless.

<https://inspire.ec.europa.eu/forum/discussion/view/261060/data-specification-on-environmental-monitoring-facilities>

1.2.3. GNSS stations and EF Scope [230 views]

The question pertained to whether GNSS (assuming Global Navigation Satellite Systems) are relevant to INSPIRE and if such data could be provided via the EF specification. Answer was that EF can handle such data, and probably in INSPIRE scope.

<https://inspire.ec.europa.eu/forum/discussion/view/261427/gnss-monitoring-station>

1.2.4. EF&O&M Nitty Gritty [281]

A very informative deep dive into the nitty gritty of INSPIRE EF modelling. What starts as a simple question pertaining to the link between EMFs and their observations blossoms to cover a wide range of important aspects, from the hierarchy of the abstract classes to the importance of clear URIs for referencing.

<https://inspire.ec.europa.eu/forum/discussion/view/227809/environmentalmonitoringfacility-hasobservation-attribute>

1.3. Overview / list of relevant existing applications, services (Title, description, URL link)

1.3.1. Ad-Hoc Air-Quality API

Air quality data fulfilling all INSPIRE requirements provided by SensorThings API:

API: <https://airquality-frost.docker01.ilt-dmz.iosb.fraunhofer.de/v1.1>

Viewer: <https://wg-brgm.docker01.ilt-dmz.iosb.fraunhofer.de/servlet/is/121/>

1.3.2. *Linked EF Example*

A simple static EF example with two sampling points, but including data, all references properly linked, viewable in QGIS

https://github.com/DataCoveEU/INSPIRE_EF

1.3.3. *Austrian Air Quality Services*

Still not formally listed on the GeoPortal due to administrative obscurities, but the closest to a correctly functional EF service that could be found.

<http://luft.umweltbundesamt.at/inspire/wfs?service=WFS&version=2.0.0&request=GetCapabilities>

<http://luft.umweltbundesamt.at/inspire/sos?service=SOS&request=getCapabilities&version=2.0.0>

1.3.4. *French German Water*

Data from both the German and French sides of the Rhine River, integrating data from the German Bundesland of Baden-Württemberg (LUBW) with that stemming from the French Geological Survey (BRGM) and the French Office for Biodiversity (OFB) (via its environmental information systems research center - INSIDE). This data covers spatial sources ranging from the basic river network information covered by the INSPIRE Theme Hydrography with additional river features supplied by the INSPIRE Theme Transport Networks - Water over water measurement stations provided in accordance with the INSPIRE Theme Environmental Monitoring Facilities to known flood risk zones provided under the INSPIRE Theme Natural Risk Zones, that will be exposed via OGC API - Features. This data will be complemented by dynamic data provided via SensorThings pertaining to both water quality and quantity.

Groundwater data will also be provided in the form of Hydrogeological units, their monitoring facilities served by OGC API - Features and their associated raw quantity observations provided by SensorThings API.

One interesting aspect of this combination of datasets will pertain to the overlaps in data maintained by different MS, with the French River Networks and Aquifers extending into Germany. A further duplication will be created pertaining to Environmental Monitoring Facilities, as we aim to provide these via both the OGC API - Features as well as SensorThings API; as far as possible these parallel datasets will provide cross references.

Potential Use Cases in this context pertain mostly to flooding within the Rhine catchment area, including both surface and ground water, but can also extend to navigability of French water transport networks based on water levels.

Some simple use cases pertain to creating the necessary links between the French and German rivers. At present the identifiers are national, the only link between these feature sets are spatial. An application that tries to extract corresponding features between these two datasets would be highly valuable.

Currently available endpoints:

- Viewer: <https://api4inspire.k8s.ilt-dmz.iosb.fraunhofer.de/servlet/is/107/>
- France
 - Ground Water STA: <https://sensorthings.brgm-rec.fr/SensorThingsGroundWater/v1.0>
 - Surface Quantity STA: <https://iddata.eaufrance.fr/api/stapiHydrometry/v1.1>

- Surface Quality STA: <https://sensorthings-wq.brgm-rec.fr/FROST-Server/v1.0>
- Germany
 - Water STA: <https://lubw.k8s.ilt-dmz.iosb.fraunhofer.de/v1.1>

1.4. Overview and assessment of the availability of thematic domain data sets in the EU Geoportal

The Figure 1 provides an overview of the availability of EF datasets on the Geoportal.

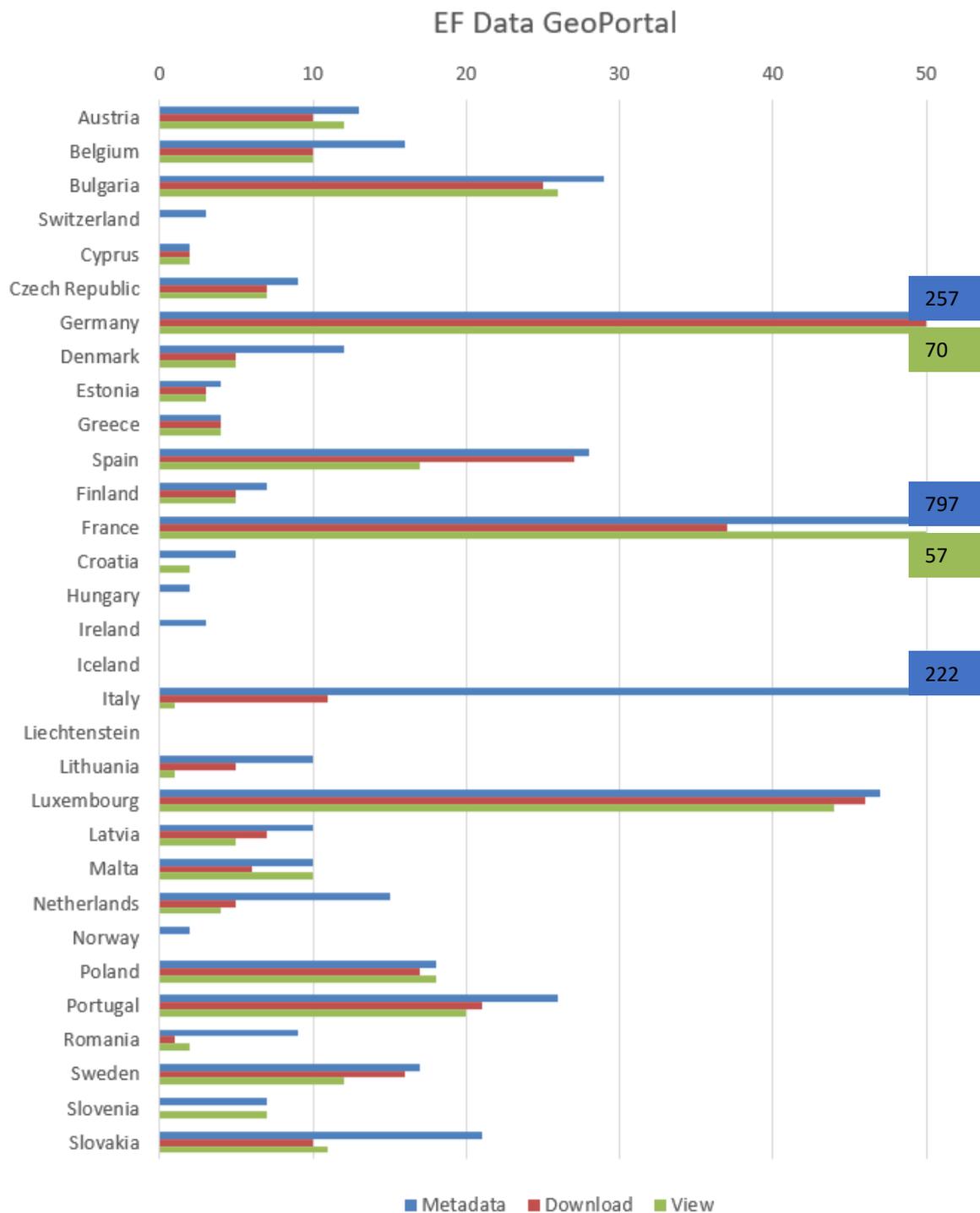


Figure 1: Overview of INSPIRE Services by Country

The visualization also clearly shows the discrepancy between theory (datasets for which a metadata record has been provided) and praxis (datasets for which actual view or download services are available). This is further highlighted in the diagrams below, that show the percentage of view and download services available in comparison to the number of datasets for which metadata records have been reported.

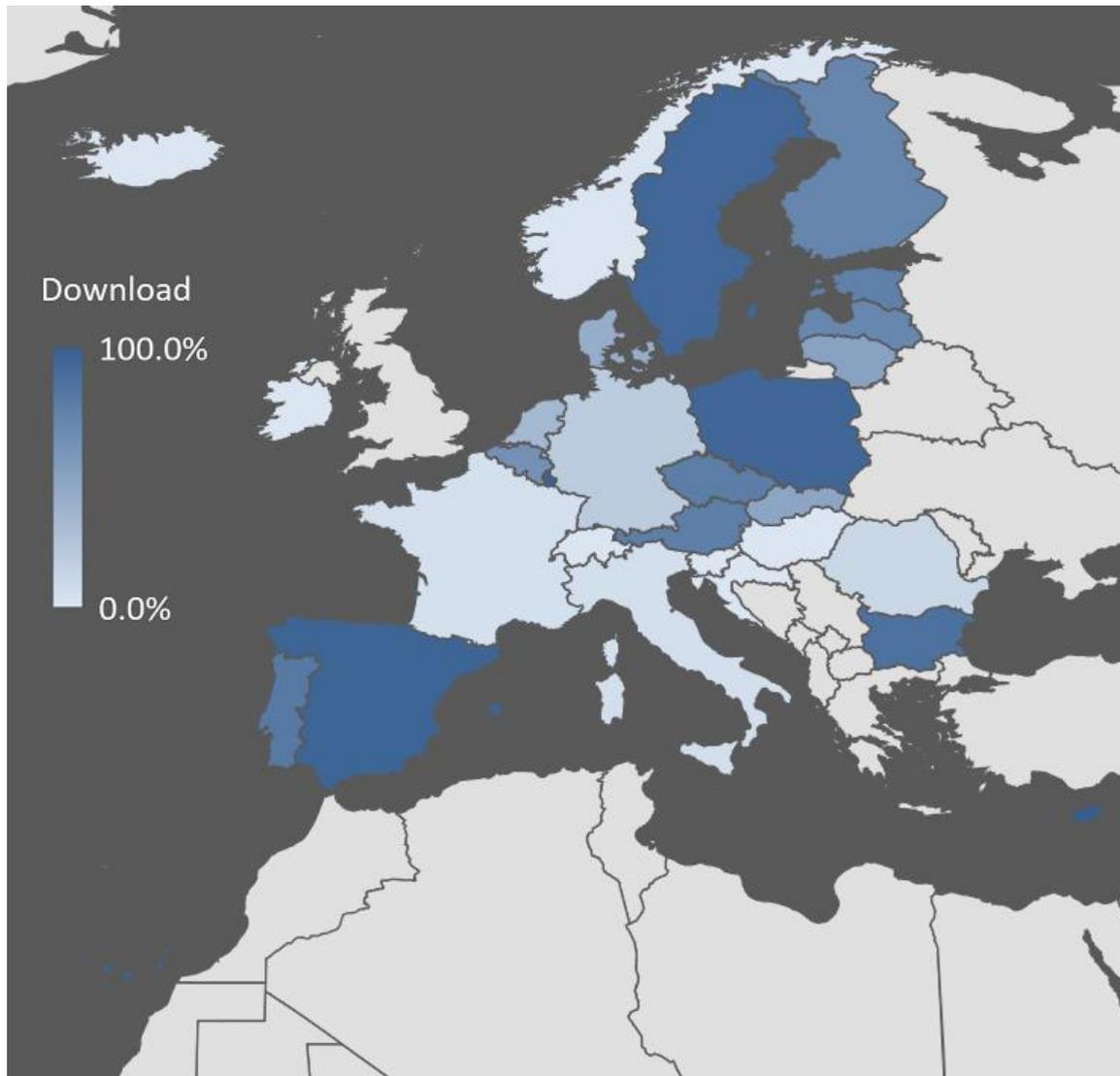


Figure 2: Percentage datasets available as Download Service by Country

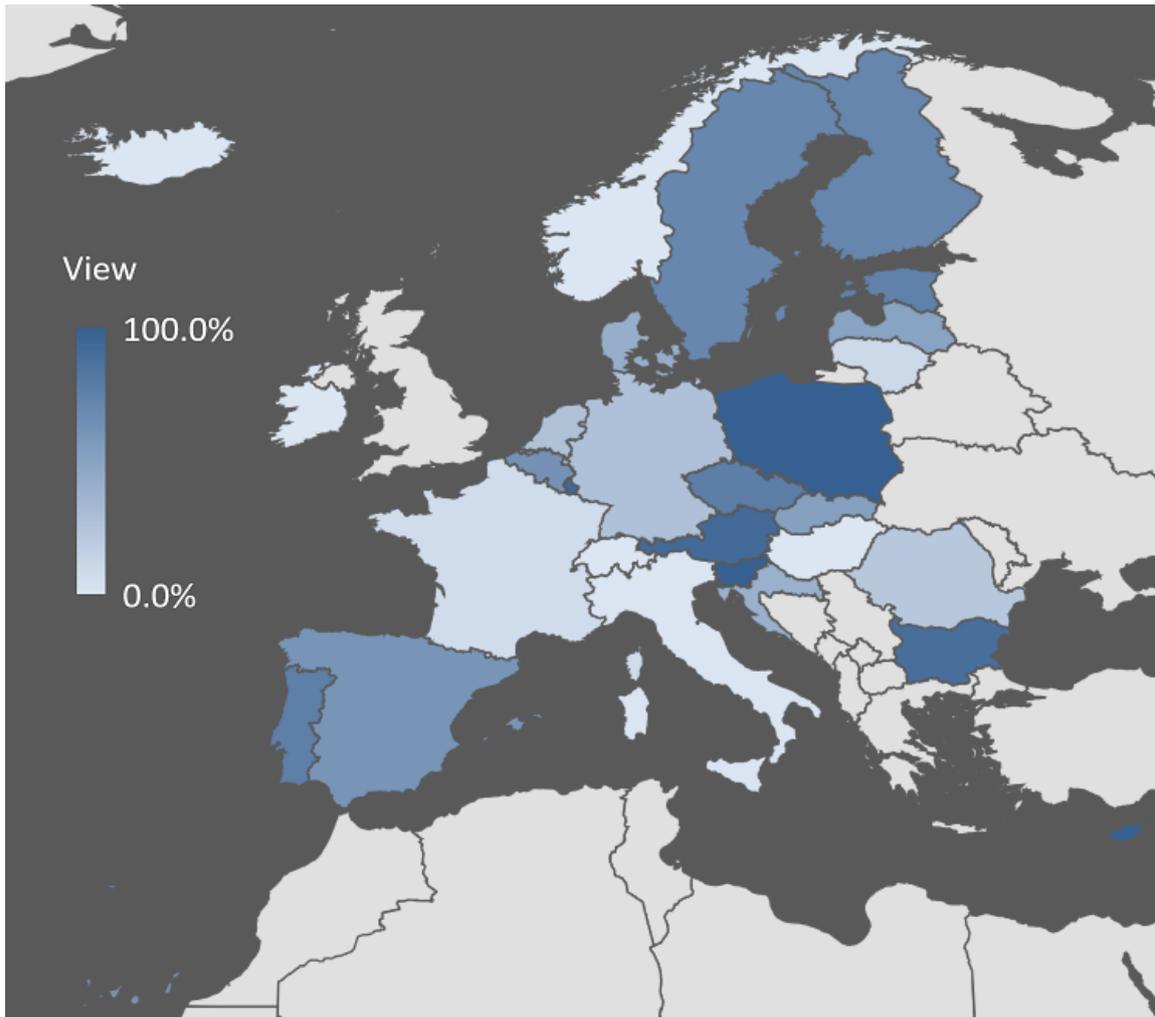
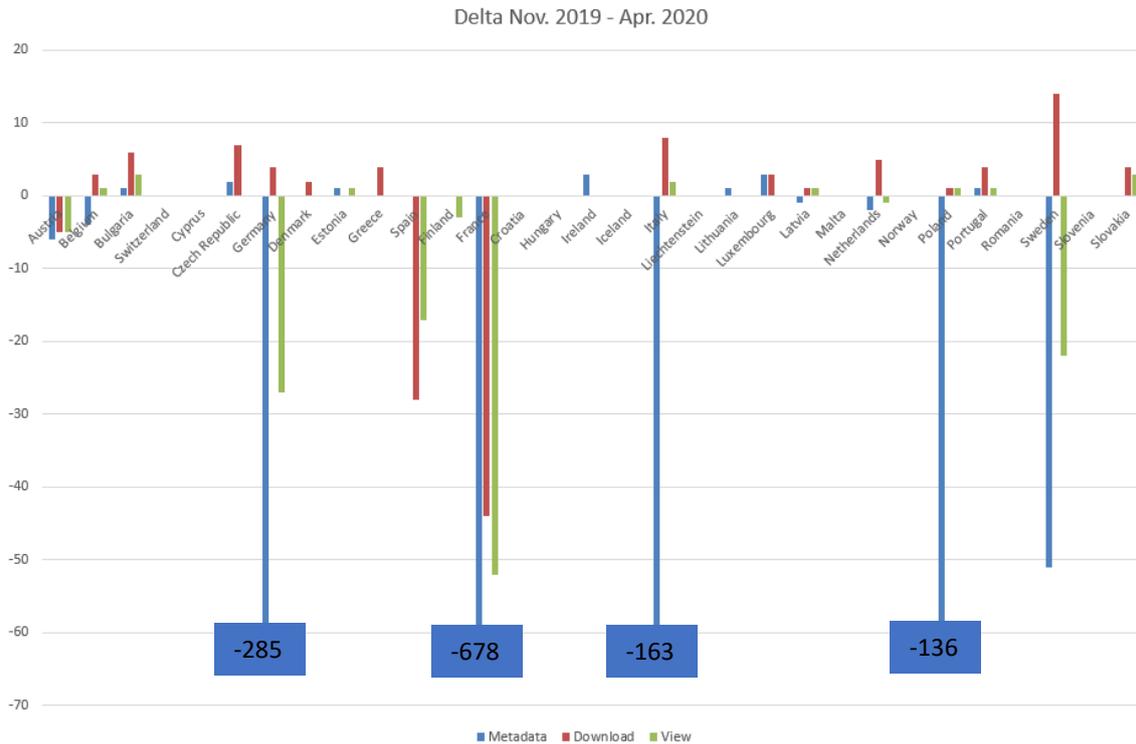


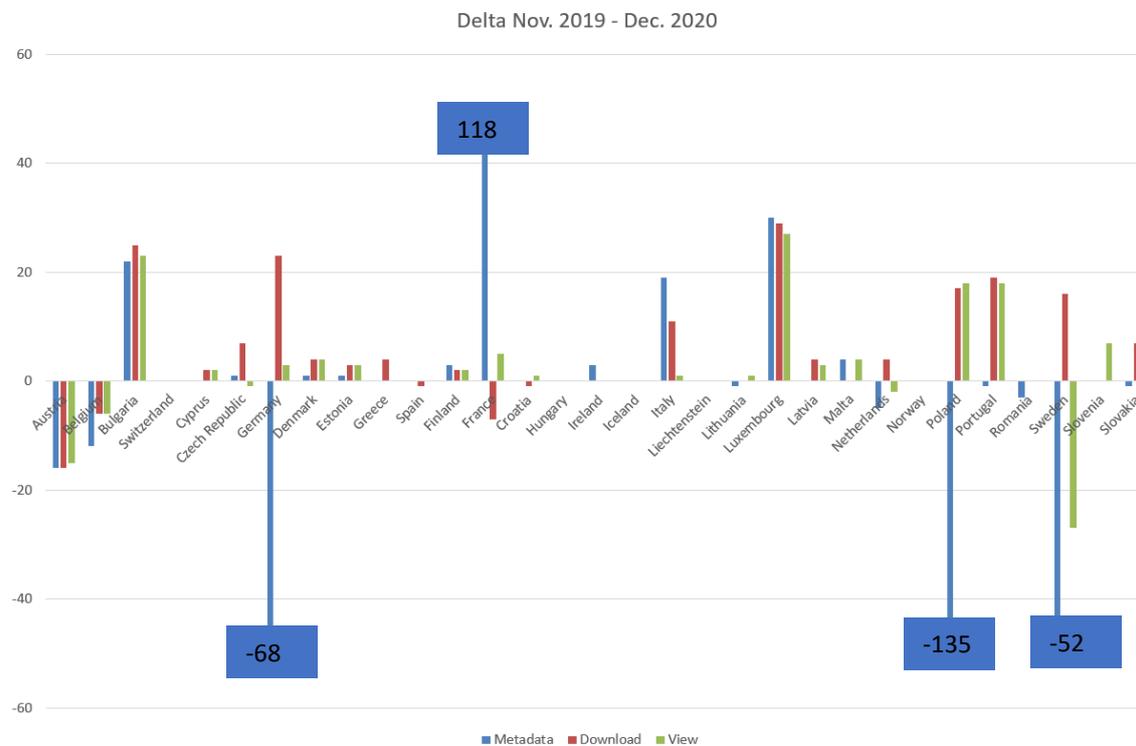
Figure 3: Percentage datasets available as View Service by Country

This gap should have long been closed, at least through the provision of non-harmonized download services.

Interesting is also the fluctuation in number of metadata, view and download service records available to the Geoportal by MS. A bit troubling is the marked decrease especially in the number of metadata records provided by some MS, whereby this could also just be a sign of “housekeeping”, with administrators revisiting and cleaning the data being provided. We first provide the perspective from last spring, where a great deal of metadata records were removed.



During the summer and fall of 2020 it seems that many of these metadata records were reinstated, leading to the following diagram:



1.4.1. Missing datasets

Several European environmental reporting obligations require member states to set up monitoring facilities within their countries as well as report data on these facilities, and at times on their data, to the European Environment Agency. Minimal Set is:

- Air Quality (AQD)
- Water Quality/Quantity (WFD)
- Bathing Water
- Waste Water (UWWTD)

Thus it is strange that several European MS have less than 4 metadata sets mentioned.

In addition, there should at least be unharmonized data available by now, but half the MS have 0 datasets listed under the download service, over a third do not provide a view service. Also, where download services are indicated, these very often do not work.

1.4.2. Withheld datasets

To my understanding, the publication of measurements on bathing water quality is obligatory. I find it strange to find this information withheld in the EF data. The following was available from Luxemburg¹:

```
<ef:hasObservation  
nilReason="http://inspire.ec.europa.eu/codelist/VoidReasonValue/Withheld">
```

1.4.3. Wrongly listed datasets

PS data is often provided under EF (example referenced below), my subjective impression is that as PS pertains to the Environment, people often wrongly assume that also pertains to EF. It may be worth clarifying the link between PS and EF (actually between SD and EF) to the community, the possibility of linking occurrence data from EFs to SD.

SD-like data also appears under EF, i.e. grids with references to species occurrence².

There are also many noise datasets³ under EF. This has long been unclear to me where this goes. Modelled noise data is foreseen under human health, many of these datasets are double listed, unclear if some primary noise measurement data will follow, but to my understanding, most noise data is currently modelled.

¹ https://inspire-geoportal.ec.europa.eu/download_details.html?view=downloadDetails&resourceId=%2FINSPIRE-93ee1068-1dc3-11e7-a02d-52540023a883_20190726-120451%2Fservices%2F1%2FPullResults%2F201-220%2Fdatasets%2F18&expandedSection=metadata

² https://inspire-geoportal.ec.europa.eu/download_details.html?view=downloadDetails&resourceId=%2FINSPIRE-c1e5f7f2-3b35-11e9-a83c-52540023a883_20191023-154828%2Fservices%2F1%2FPullResults%2F15881-15900%2Fdatasets%2F9&expandedSection=metadata

³ https://inspire-geoportal.ec.europa.eu/download_details.html?view=downloadDetails&resourceId=%2FINSPIRE-c1e5f7f2-3b35-11e9-a83c-52540023a883_20191023-154828%2Fservices%2F1%2FPullResults%2F19021-19040%2Fdatasets%2F11&expandedSection=metadata

INSPIRE Community Forum on Environmental Monitoring & Observations	p. 12 of 16
Report (Phase 2 – D3 - 2020)	2020-12-29

2. OVERVIEW OF THE FACILITATOR'S ACTIVITY

2.1. Facilitator Activity 04-2020 – 12-2020

2.1.1. Forum Activity

In the course of the general monitoring of forum activity, diverse topics have been addressed, clarification and support provided for various issues. Bugs reported by forum users have been analyzed and reported, potential solutions proposed.

2.1.2. INSPIRE Conference 2020 Virtual

Despite the virtual nature of the 2020 INSPIRE Conference, we managed to spike a lot of interest via talks on various domains and technologies. Talks were held on the following topics:

- INSPIRE Coverages - Schema Modifications for WCS: an overview of the modifications required to the existing coverage based INSPIRE Data models for provision via WCS. This work has culminated with this proposal being accepted as an Candidate INSPIRE Good Practice:
<https://inspire.ec.europa.eu/good-practice/ogc-compliant-inspire-coverage-data-and-service-implementation>
- DemographyThings – an interesting alternative approach to providing Demography Data within an SDI

In addition, the API4INSPIRE Project held an indepth Webinar on both OGC API – Features and OGC SensorThings API, showing the potential of both of these new technologies to greatly enhance the data sharing process. Both APIs have now been successfully endorsed as INSPIRE Good Practices, for details, see: <https://inspire.ec.europa.eu/portfolio/good-practice-library>

2.1.3. INSPIRE Community Forum Webinar

At the INSPIRE Community Forum Webinar, we assured that in addition to learning about the various exciting new developments presented, participants were able to directly interact with live endpoints, giving them a far more visceral experience. Talks at this event included information on the following topics:

- French-German Water Data: resulting from API4INSPIRE, this cross border dataset gives us an outlook at what INSPIRE has yet to become
- DemographyThings: starting from the NUTS based SensorThings deployment, we extended this to gridded data stemming from Statistics Poland, providing various statistical metrics on the European 1km Grid.
- CovidThings: A further novel usage of OGC SensorThings API, CovidThings were proposed by the GO-PEG project, and deployed by API4INSPIRE

Thus, despite the sadness that the Forum must now be closed down, we did manage to go out with a bang.

2.1.4. API4INSPIRE

The API4INSPIRE project is exploring the benefit of the introduction of the new OGC API based standards OGC API – Features and OGC SensorThings API into the INSPIRE and beyond domain. An evaluation methodology has been defined for assessing the costs and benefits incurred in introducing these new technologies, and a deployment plan created.

The API4INSPIRE project foresees the provision of 3 data nests, providing spatiotemporally collocated sets of complementary data, openly available for experimentation with data provision via the new APIs. These data nests can be summarized as follows:



- **Airy Austria:** A collection of air quality and meteorology data complemented with air transport data. The air quality data has now been extended across a large stretch of central Europe.
- **Urban Data Platform Hamburg:** Various Smart City Sensors from the city of Hamburg paired with road traffic networks. In addition, access to sensors within Energy Campus of the Hamburg University of Applied Sciences provides a wide field for experimentation with the SensorThings API.
- **Franco-Germanic Flow:** In this nest we focus on water resources on both sides of the Rhine river. The provided datasets include hydrography, hydrogeology and transport networks water together with water quantity and quality measurements and information on flood risk.

In addition, due to Covid-based replanning of the project, a fourth data nest emerged triggering our activities towards demography and Covid Case data. The planned face-to-face events were replaced with various virtual events and stronger interactions with interested parties.

This project culminated in the ELISE Webinar held on November 19th; all presentations and recordings are available from:

<https://joinup.ec.europa.eu/collection/elise-european-location-interoperability-solutions-e-government/document/presentation-sensorthings-api-brings-dynamic-data-inspire>

While the final evaluation is still outstanding, based on interim findings, both APIs have been deemed well suited for utilization within INSPIRE, Good Practice status has been given to both APIs for use as INSPIRE Download Services.

2.2. Outreach

One interesting surprise this year was discovering that Egypt is now also in the process of implementing INSPIRE as a national SDI. At present, there is no central coordination for this work, with the technical responsables currently being mentored by DataCove staff in view of other options. For the next years, we are exploring routes of more formalized collaboration, better integrating the Egyptian deployments with new developments in Europe.

3. FACILITATOR'S SUGGESTIONS FOR IMPROVEMENTS

In addition to closely monitoring the forum activity pertaining to Environmental Monitoring Facilities and the use of the Observations and Measurements schema within INSPIRE, the facilitator has also been engaged in various other domains, either those pertaining to the utilization of O&M, those related to ongoing work on the UN FAO GloSIS and also general issues that pertain to a wide variety of data themes.

On this general level, there is still a lack of clarity pertaining to the identification of features being provided. While various documents have been created providing suggestions on how to provide a consistent and resolvable identifier scheme, MS are still looking for formal guidance on this topic. This topic is well discussed in the following thread.

<https://inspire.ec.europa.eu/forum/discussion/view/264948/inspireid-guidance-for-the-inspire-priority-datasets-and-environmental-reporting-obligations>

3.1. Atmospheric & Oceanographic

Various issues have emerged within the Atmospheric & Oceanographic domain. As these are closely related to O&M issues, they are also covered here.

Two of the issues pertain to the provision of trajectory and profile observations within this domain. The concerns here are twofold:

- To what extent are the profileObservation and trajectoryObservation types provided within the GCM formally foreseen for provision within INSPIRE. While these datatypes aptly reflect the types of data to be provided, they are marked as “informative”. Guidance would be appreciated on if these types may be used for the provision of INSPIRE data.
<https://inspire.ec.europa.eu/forum/discussion/view/264104/profileobservation-and-trajectoryobservation-valid-for-of-data>
- In addition, it is presently not possible to correctly provide data for a trajectoryObservation, as the timeLocationValueTriple foreseen for the provision of the resulting values is defective, allowing only for Time and Location, no Value.
<https://inspire.ec.europa.eu/forum/discussion/view/166102/trajectoryobservation-result-omsotimelocationvaluetriple-defective>

The marine community would also be interested in harmonizing the work required in data provision for EMODnet vs. INSPIRE. EMODnet utilizes CDI files for the provision of metadata; while these are also based on the ISO 19115 format, there are subtle differences in how the data is to be provided. In addition, reuse of the EMODnet bathymetry data (BAG files) has been discussed. At present, there are no known activities on harmonizing these disparate data formats, requiring all data providers to generate two different formats for data provision.

<https://inspire.ec.europa.eu/forum/discussion/view/264053/which-are-the-issues-on-inspire-compliance-of-emodnet-bathymetry-cdis>

In addition, there is still a lack of clarity as to what data is to be provided under INSPIRE Themes. While some data providers have understood that providing monitoring data implies providing data on the environmental monitoring facility generating this data, others are working on the assumption that this is not necessary, seeing the individual INSPIRE themes as unrelated silos. For those data providers interesting in providing linkage, no official guidance is available.

<https://inspire.ec.europa.eu/forum/discussion/view/263990/implementation-of-relations-from-of-to-ef-and-sr>

3.2. Soil

Several of the current issues pertaining to the soil domain are in regard to the codelists to be used to annotate the data provided. At present, most of the codelists provided for the soil domain are empty (especially troubling as they are also marked as not extendable, thus not giving MS the option or providing alternative references). As many of these codelists have been created during the specification of the FAO GloSIS data model, it would be worth investigating if these resources could either be imported to the INSPIRE registry, or if alternatives for provision and use of these codeslists within INSPIRE could be found.

<https://inspire.ec.europa.eu/forum/discussion/view/232658/wrb-soil-type-classification>

<https://inspire.ec.europa.eu/forum/discussion/view/26781/technical-questions-regarding-and-examples-for-the-handling-of-registries-and-their-entries>

<https://inspire.ec.europa.eu/forum/discussion/view/264219/how-to-provide-a-observableproperty-in-a-valid-gml-file-for-the-soil-theme>

One especially pressing issue in the soil domain pertains to a missing attribute connecting the SoilDerivedObject to its corresponding observations. This issue is twofold:

- In the 4.0 version of the INSPIRE Soil Schema, the association soilDerivedObjectObservation was missing from the schema. It has now been added to the draft version of the soil schema, but there is no clarity as to when this schema version will be formally accepted, or if data provided using it is valid.
- Based on an informal analysis of the data model, the soilDerivedObjectObservation should actually have had cardinality 0..* as all the other soil associations to Observations. Unfortunately, this error has not been corrected, allowing for only one Observation to be provided per object (not realistic)

<https://inspire.ec.europa.eu/forum/discussion/view/186450/missing-associations-to-om-observation-in-xsd>

Concerning is also the lack of clarity pertaining to the scope of data to be provided. Based on the INSPIRE Directive the general understanding is that data available to the data provider and corresponding to the concepts defined by the INSPIRE feature types is to be provided. However, data providers are quite creative in their argumentation as to why data is not to be provided. In one case, a statement pertaining to minimal metadata requirements is used to argue that data need not be provided.

<https://inspire.ec.europa.eu/forum/discussion/view/265305/minimum-features>

Finally, as in all INSPIRE themes, complete and realistic examples would provide a great deal of help to data providers in understanding the formal requirements as well as various technical aspects of encoding such as the correct usage of xlink (also related to the general point above pertaining to identifiers).

<https://inspire.ec.europa.eu/forum/discussion/view/265180/soil-theme-struggling-with-conversion-to-soil-site-soilplot-and-observedsoilprofile-in-fme>

3.3. OGC SensorThings API

Now that the OGC SensorThings API has achieved INSPIRE Good Practice status, it would be important to maintain the momentum and provide support for widescale deployment. At present API4INSPIRE is covering this role, with Fraunhofer IOSB (developers of the FROST implementation) dedicated to maintaining the resources created in this project. At present, alternative avenues of support are being investigated.

4. CONCLUSIONS

While MS continue to progress in their implementation of the INSPIRE requirements, there are several pressing issues that make this nearly impossible for at least some thematic areas. These issues pertain to the following areas:

- **Codelists:** This has been an issue since the onset of INSPIRE, with clear codelist requirements from the UML data specifications not being correctly formalized to the IRs or provided via the INSPIRE registry. While in some cases it was possible to remediate these issues (e.g. for EF where defined codelists were not transposed, the content has been provided via the registry regardless. Unclear is to what extent the use of these codelists are mandatory since the IRs remain unclear). In other cases, these issues persist, as described in various topics above

INSPIRE Community Forum on Environmental Monitoring & Observations	p. 16 of 16
Report (Phase 2 – D3 - 2020)	2020-12-29

- **Errors in Schema Files:** In some cases, the transposition from the UML data models to the XSD schemas made available for use by MS was not performed correctly. While these issues have been repeatedly thematized, little to no progress has been made. Providing corrected schema files as draft versions is not satisfactory.
- **Identifiers:** Again, an old issue, with various recommendations, but no clear guidance forward. This is especially distressing as disparate use of identifier schemes will hinder interoperability. While it is clear based on the current state of the legislation that the EC cannot require a specific solution, a strong recommendation could provide guidance to MS.
- **Examples:** a recurrent issue across themes is the lack of examples. For EF, this issue has been addressed by the creation of a consistent example set made available on GitHub, together with various pages providing links to existing good practices. Such resources would be valuable for all data themes.