GIS Data and Noise Maps: Shall They be INSPIRE Compliant?

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Summary
Environmental noise is increasingly been recognized globally as an issue of concern. Substantial volumes of data are required in order to properly assess noise exposure of EU citizens, and to be inform on measures for reducing the associated health risks. That is why there is a system which is being put in place with the aim of monitoring the state of environmental noise throughout the European Union. The European Directive on the Assessment and Management of Environmental Noise (2002/49/EC) (END) aims to establish a common approach to assess the exposure to environmental noise throughout the EU. Within this context however there is still no means for combining, and comparing data from the 28 EU Member States with their different languages, data infrastructures and modelling approaches. At the same time, recent developments after the adoption of the Infrastructure for Spatial Information in Europe (INSPIRE) and its implementing rules, following the principles of the Shared Environmental Information System (SEIS) provide a solid foundation for streamlining the exchange and efficient use of noise-related data. This manuscript investigates the potential value added from ensuring compliance of geospatial data and noise maps within INSPIRE. It investigates both the issues of data harmonisation and the use of interoperable web based services for accessing spatial data.

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1. Introduction

Some recent advancements, related to the establishment of a pan-European spatial data infrastructure (SDI) and Shared Environmental Information System (SEIS) [1] can act as a catalyst and improvement of data utilization with respect to the reporting and implementation of the European Union Environmental Noise Directive 2002/49/EC (END) [2]. The Infrastructure for Spatial Information in the European Community (INSPIRE) [3] provides the principles and legal framework for data management to be applied in various stages of the implementation of END. Shared, harmonised and discoverable spatial data, demanded by the roadmap of INSPIRE can also support the data collection needs and practices used for the development and assessment of noise strategic maps. In addition, action plans designed to reduce noise and mitigate related effects can be shared to the public through the existing service nodes of the European SDI. Finally, data flows reporting on the state of environment and END implementation to the EC and EEA can be updated using web-based services and applying the concept of e-reporting. In this paper we describe the added value from the adoption of INSPIRE to the needs of the noise community in Europe, and provide a use case in which data from neighbouring countries are mapped to the data specifications, defined by INSPIRE, in order to simultaneously combine comparable data from heterogeneous sources. We provide an overview of the European context, and clarify the potential gains from the harmonisation and combined use of environmental noise data across borders and domains. Furthermore, the wide use of INSPIRE-based services allows that reported data are kept close

to their source and reused together with data from other domains such as air quality, transportation, human health, population, marine environment or biodiversity.

1.1. Shared Environmental Information System (SEIS)

Effective policy making on environmental noise related issues largely depends on the availability and quality of underpinning data and the systems needed to share this information between all concerned governance actors (i.e. policy makers and relevant stakeholders). Despite the long tradition in exchanging environmental information in Europe there are still numerous challenges not permitting an easy use of environmental information across borders and across domains. This is caused by numerous interdependent factors, inherent to one of the key characteristics of Europe - its diversity. To just name a few of the factors contributing to this diversity: the 24 official languages used in EU, the completely different workflows between countries, the broad diversity of proprietary and open source tools in use, differences in the culture and traditions of sharing data, etc. In response to that the European Commission together with EU Member States are working on the establishment of SEIS and laying down the foundation of INSPIRE.

1.2. Infrastructure for Spatial Information in the European Community (INSPIRE)

The INSPIRE Directive [4] aims to provide harmonised, well documented spatial information available to support environmental related policies in Europe. This legally binding framework paves the road for European countries to build a common SDI. INSPIRE is subdivided into 34 data themes, related to the environment. They are however not detached from each other, but create one single fabric. Besides the data themes, INSPIRE requires that a set of interoperable web-based services are established which aim allow for enhanced data discovery, visualization and download functionalities, thus significantly improve data accessibility. INSPIRE is already enabling the sharing of environmental spatial information among public sector organizations and better facilitate public access to spatial information across Europe. The implementation process of the INSPIRE Directive should be completed by the end of 2019. It adopts a step-wise approach where the overall process is improved by feeding into the guidance documentation new technological advancements and the lessons learned from the actual implementation. INSPIRE is a framework Directive and its implementation is specified by implementing rules given as a Commission Regulation/Decision documents, developed via a transparent and participatory bottom-up process. These legal documents provide detailed directions on the development of the INSPIRE components: metadata, network services and interoperability of spatial data sets and services [3].

1.3. Reporting of environmental noise data in Europe

The Environmental Noise Directive - 2002/49/EC (END) [2] defines a common approach intended to avoid, prevent or reduce the harmful effects, including annoyance, due to the exposure to environmental noise. The European Commission assessed the degree of comparability of the results generated by the various methods after the first cycle of strategic noise mapping (2006-2007) and found out that, there are many cases in which assessment methods used by the Member States differ significantly from the interim methods [4]. Other assessments in the past have shown that differences in methodological approaches made it difficult (if at all possible) to obtain consistent and comparable figures on the number of people who are being exposed to noise levels within one, or across EU Member States [5], [6]. Difficulties relate, inter alia, to: (a) incompleteness of the reporting of strategic noise maps by MS; (b) the different quality and format of data reported at EU level; (c) the different assessment methods used; (d) the different strategies adopted concerning the selection of e.g. roads to be mapped; (e) the distribution of the populations and dwellings within buildings and (f) the unavailability or reliable dos-response curves required for health impact assessment.
Lately, a Report of the Commission on the implementation of END in accordance with Article 11 of Directive 2002/49/EC, released in 2011 (COM(2011) 321 final) [7] defines four main directions in which the implementation of the Environmental Noise Directive can be improved. Firstly, the European Commission refers on the need of finalising the framework for assessing noise exposure in Europe that started in 2008 (CNOSSOS-EU project [8], [9]). In this context the new Annex II of the END is being revised. was revised on the basis of the CNOSSOS-EU methods and is under scrutiny by the European Parliament before the new EU regulation will be established and become effective in the EU Member States starting from 2018. Also, implementation of the legislation on environmental noise deals with a number of cross cutting issues such as the advantages in coordination and integration of air quality and noise management that would imply coordinated assessments, action plans and, reporting to the European level, and dissemination of information to the public.

2. Shall GIS data and noise maps be INSPIRE compliant?

A quick check at the European Environment Information and Observation Network (EIONET, `www.`

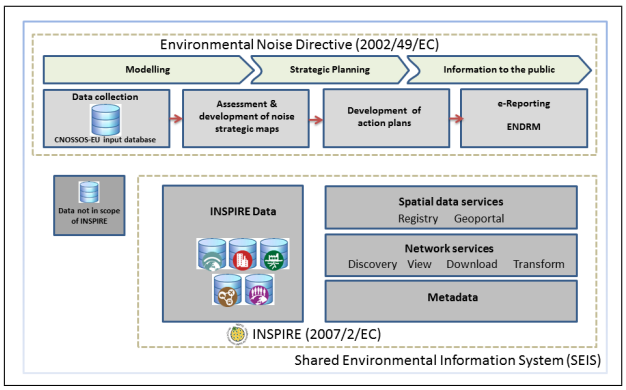

Figure 1. Relationship between INSPIRE and END.

eionet.europa.eu) shows that there are already significant volumes of noise-related data which are made available by EU Member State reporting authorities. However, after analysing sample datasets it becomes evident that the data are difficult to combine and use together. Within this context, the implementation of INSPIRE as a single European SDI framework, within the broader context of the SEIS would lead to data harmonisation, thus facilitating the exchange and use of environmental noise data across Europe. INSPIRE already provides numerous building blocks (Figure 1) which can be reused in the context of noise to encode data in a similar manner, thus achieving significant gains from the improved data interoperability.

Furthermore, we consider that data which are increasingly been made available as result of the implementation of INSPIRE can be used as (a) input for environmental modelling, (b) strategic planning purposes and (c) dissemination to the public through interactive maps. That is why we see the potential gains from the implementation of INSPIRE in the following directions:

2.1. Common rules for harmonisation of data for strategic noise mapping

INSPIRE is establishing a structured approach to the entire cycle of noise data management, including the data collection, the development of noise strategic maps, and the development of noise action plans. The key contribution of INSPIRE is the obligation to allow access to spatial data, even if it is still not mandatory to submit these data. For instance to build up a noise map different datasets are needed, such as the exact location of people (and not simply an average statistics), the terrain model, highly detailed infrastructures and buildings, local meteorological data, detailed data on transportation networks. All these data, that shall be used while producing noise maps, under INSPIRE become accessible and available for a range of other applications.

2.2. Common SDI used in the preparation of action plans

Policy making depends on a solid knowledge base which largely relies on the availability and quality of underpinning data and the systems needed to share information between all governance actors. This is of particular relevance for complex phenomena posing serious health risks such as environmental noise pollution. The action plans (e.g. noise action plans) which shall be developed in accordance with the END serve this purpose, and can use INSPIRE to enhance their consistency, as increasing volumes of data are made available through INSPIRE.

2.3. Interactive maps for communicating noise-related issues to the public

The END requires Member States to publish strategic noise maps and action plans. Member States publish their noise maps and action plans, but there is currently a great diversity in how this is done. Most countries established interactive web maps for this purpose, while others provide static documents. At the same time INSPIRE provides the requirements and guidance for setting up interactive web maps, so that they are published through the national INSPIRE infrastructures. In this way the interactive maps can be discovered through the national and European geoportals.

2.4. INSPIRE supports and facilitates environmental noise reporting

The END has several cyclical reporting obligations which, in some cases, create an additional administrative burden without generating the necessary added value for EU action. The streamlining of reporting and the electronic reporting processes could be further optimised [10]. Implementation activities under the INSPIRE Directive may lead to the consideration of further alignments, in particular in relation to the sharing of spatial data and services. Indeed this Directive lays down a number of rights and obligations regarding the sharing of spatial data sets and services between all levels of government (public authorities). According to Art. 4(1) [3], the arrangements apply to all spatial data sets which relate to one or more of the 34 data themes listed in the INSPIRE annexes I to III, are in electronic format, and refer to an area where a Member State has and/or exercises jurisdictional rights. The arrangements apply to public authorities and/or entities/organisations managing or requiring the spatial data or services on their behalf. Article 17 [3] defines the data sharing requirements in more detail. It requires Member State to adopt measures for the sharing of spatial data for the purposes of public tasks that may have an impact on the environment. The measures should preclude any restrictions likely to create practical obstacles to the sharing

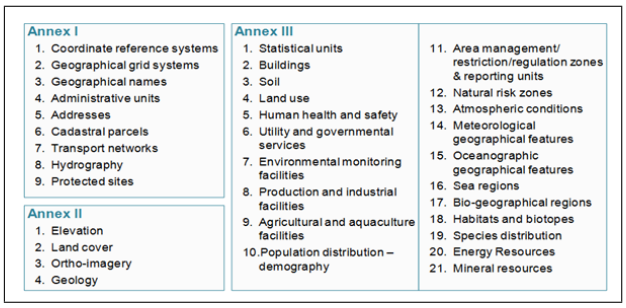

Figure 2. Data themes within the scope of the INSPIRE Directive.

which might occur at the point of use. For this reason, INSPIRE will make it easier for organizations that require spatial information to perform their duties for END-related activities and health risk analyses of noise exposure.

2.5. INSPIRE helps to connect to other domains

By adopting common data management practices, thematic communities are unlocking data so that they can be re-used easily and effectively in other domains. This allows data to be simultaneously connected across borders and across domains, for example bringing together data for noise, air quality, transportation, human health, population, marine environment, and biodiversity. The noise community has been embracing these practices for INSPIRE-compliant reporting. They are aligning the reporting content and dataflow. In this way, the obligation to report to the European Commission is fulfilled, and the reported data can be further re-used. This provides an efficient way to integrate noise data with other information to get new insights in support of environmental decision making. Moreover, INSPIRE is an 'enabling' infrastructure for SEIS: by implementing INSPIRE, we take a major step forward in building a SEIS faithful to its principles [1].

2.6. INSPIRE helps 'unlock' noise-related data

European data providers, such as municipalities, ministries and mapping agencies that manage data, falling within the scope of one of the 34 INSPIRE data themes (Figure 2) cannot deny access to them, and are obliged to establish interoperable web-based services. For environmental noise the relevant data themes include at least: "Area management/restriction/regulation zones and reporting units", "Human Health and Safety", "Transport networks", "Statistical Units"; "Administrative units" and "Population distribution - demography".

3. CONCLUSIONS

The first cycle of environmental noise reporting collected significant volumes of data in relation to the obligations, defined by the END, regarding the major noise sources in Europe. At the same time there are still cases where data is limited, or not easily accessible. We consider that adopting the SEIS principles [1] for data within the scope of END would further improve the accessibility and usability of noise data sets. The establishment of a pan-European SDI, as result of the implementation of INSPIRE and most of all the exposure of harmonised data through interoperable web services will minimize the efforts for both users and providers of geospatial data on environmental noise.

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