



## Advances in the development of common noise assessment methods in Europe: The CNOSSOS-EU framework for strategic environmental noise mapping



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### HIGHLIGHTS

- A common methodological framework for noise assessment across Europe (CNOSSOS-EU).
- Tackling scientific, technical, technological implementation challenges before CNOSSOS-EU becomes operational in the EU MS.
- Efficient and consistent implementation of the European Noise Directive 2002/49/EC.

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### ABSTRACT

The Environmental Noise Directive (2002/49/EC) requires EU Member States to determine the exposure to environmental noise through strategic noise mapping and to elaborate action plans in order to reduce noise pollution, where necessary. A common framework for noise assessment methods (CNOSSOS-EU) has been developed by the European Commission in co-operation with the EU Member States to be applied for strategic noise mapping as required by the Environmental Noise Directive (2002/49/EC). CNOSSOS-EU represents a harmonised and coherent approach to assess noise levels from the main sources of noise (road traffic, railway traffic, aircraft and industrial) across Europe. This paper outlines the process behind the development of CNOSSOS-EU and the parts of the CNOSSOS-EU core methodological framework which were developed during phase A of the CNOSSOS-EU process (2010–2012), whilst focusing on the main scientific and technical issues that were addressed, and the implementation challenges that are being faced before it can become fully operational in the EU MS.

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### 1. Introduction

A reliable estimation of the exposure to environmental noise of European Union (EU) citizens is a pre-requisite to support and evaluate an informed policy on noise reduction at European level. One of the objectives of the European Directive on the Assessment and Management

of Environmental Noise (2002/49/EC) (END) is to establish a common approach to assess the exposure to environmental noise throughout the EU. For this purpose, a set of common noise indicators is defined in the Directive, namely the day-evening-night level  $L_{den}$  and the night level  $L_{night}$ . The EU Member States (MS) are required to produce strategic noise maps on a five-year basis for all major roads, railways, airports and agglomerations pursuant to Article 7 (1) starting from 30 June 2007. The outcome of these maps is being used by the Competent Authorities in the EU MS to identify priorities for action planning (aimed at reducing or avoiding exposure to harmful noise levels), and by the European Commission (EC) to assess the number of people exposed to noise and to inform the general public about it.

Article 6.2 of the END empowers the European Commission to establish common assessment methods for the determination of the noise indicators  $L_{den}$  and  $L_{night}$ . Until such common assessment methods are adopted, EU MS may use either the interim assessment methods specified in paragraph 2.2 of Annex II of the END, or national methods,

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provided it has been demonstrated that such alternative methods provide equivalent results to those obtained by means of the interim methods.

The EC assessed the degree of comparability of the results generated by the different methods after the first round of strategic noise mapping (2006–2007) and established that, in many cases, the assessment methods used by the Member States differ significantly from the interim methods (DG JRC 2008). Other assessments have shown that differences in methodological approaches made it difficult (if not impossible) to obtain consistent and comparable figures on the number of people being exposed to noise levels within and across EU MS (European Commission, 2011; Licitra and Ascari, 2014). 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 dose–response curves required for health impact assessment.

The noise assessment methods used by the EU Member States, along with input data extracted from national databases, differ in several aspects (Kephelopoulou and Paviotti, 2012), such as: the formulas used to estimate the sound power output of the noise sources; the formulas used to evaluate different aspects of sound propagation; the measurement conditions under which sound power is evaluated; the databases of input values (e.g., differences in expression of basic parameters, definition of vehicle classes, correction effects, etc.); the implementation of the same method in different software packages; and the handling of software settings by the end user.

Moreover, there are differences in the input data configuration and parameter settings that are used in connection with the assessment methods such as: choice of roads, tram and railway lines within an agglomeration; number of aircraft movements within an airport; default data are often used instead of real-life scenario data (e.g. speed limit is used instead of real average speed of vehicle fleet, standard flight tracks instead of radar based movements, etc.); number of sound wave reflections in the propagation path; accuracy, completeness and reliability of geographical input data; methodology to assign noise levels to building facades and numbers of inhabitants and dwellings to buildings.

In 2008, the EC initiated the development of harmonised methods for assessing noise exposure in Europe. In the context of the project entitled CNOSSOS-EU led by the EC's Joint Research Centre (JRC) on behalf of the Directorate General for Environment (DG ENV), the core of the common noise assessment methodological framework in Europe was developed. This framework focuses on strategic noise mapping and carefully balances the need for harmonisation with the principle of proportionality and sectorial specificities in EU MS, e.g. as regard data requirements. It provides the technical basis for preparing a Commission Implementing Decision to revise Annex II of the END by which the CNOSSOS-EU methodology will become mandatory in the EU MS.

The purpose of this paper is to outline the process behind the development of CNOSSOS-EU and the parts of the CNOSSOS-EU methodological framework, whilst focusing on the main scientific and technical issues that were addressed, and the implementation challenges being faced before it can become fully operational in the EU MS.

## 2. The CNOSSOS-EU process

The main objective of the CNOSSOS-EU process is to develop a coherent methodological framework for the assessment of environmental noise and its impact on human health, enabling consistent and accurate reporting of strategic noise maps (including exposure of populations) by the EU Member States in accordance to their obligations under the END.

The development of the CNOSSOS-EU methodological framework was the fruit of an intensive and in-depth consultation which involved European Commission services, the European Environment Agency

(EEA), the European Aviation Safety Agency (EASA), the World Health Organization (WHO-Europe) and nearly 150 noise experts.

Overall, the roadmap for the development and implementation of CNOSSOS-EU includes the following steps belonging to two phases of the CNOSSOS-EU process:

1. The assessment of the equivalence of existing noise assessment methods in EU;
2. The definition of the target quality and input value requirements for strategic noise mapping in Europe;
3. The establishment of requirements and criteria for the screening, rating and pre-selection amongst existing assessment methods in EU, USA and Japan that best cover the needs and requirements of the END;
4. The conceptualisation of a 'fit for purpose' framework allowing for the application of CNOSSOS-EU methodology at two levels of detail and conformity, depending on the objectives of the assessment (i.e. strategic noise mapping on a mandatory basis – first level of application, and action planning on a voluntary basis – second level of application);
5. The selection of the components of the common noise assessment methods through a series of dedicated workshops, benchmarking/testing exercises and other ad-hoc meetings with European noise experts;
6. The drafting of the core CNOSSOS-EU methodological framework including guidelines for its competent use for strategic noise mapping and associated requirements for input data collection and modelling;
7. The preparation of the operational part of CNOSSOS-EU and a long-term planning for assisting the EU MS to reliably implementing CNOSSOS-EU in the context of the future rounds of strategic noise mapping in Europe.
8. The legal act to revise Annex II of the END and enforce CNOSSOS-EU in EU MS.

Steps 1 to 5 belong to the preparatory phase of the CNOSSOS-EU development whereas steps 6 to 8 designate the formal part of the CNOSSOS-EU process which involves an in-depth formal consultation, review, finalization, enforcement and implementation of CNOSSOS-EU with the EU Members States.

In phase A of the CNOSSOS-EU process (steps 1 to 6) the CNOSSOS-EU framework was developed (2009–2012) (Kephelopoulou et al., 2012) based on state-of-the-art scientific, technical and practical knowledge about environmental noise assessment in Europe, in connection with the experience gained during the first round of the strategic noise mapping in 2007.

The core of the CNOSSOS-EU framework consists of a quality part that describes the objectives and requirements of CNOSSOS-EU and technical parts describing: the modelling of noise emissions due to road traffic, railway traffic and industrial noise sources and the methodologies for sound propagation, aircraft noise prediction and how to assign noise levels and population to buildings. Moreover, the scope and the concept of the "Guidance for the competent use of CNOSSOS-EU" (to be developed in phase B of the CNOSSOS-EU process) were also outlined.

In the same period, the revision of the Electronic Noise Data Reporting Mechanism (ENDRM), which was led by the European Environment Agency, was successfully accomplished (European Environment Agency, 2012). ENDRM aims at facilitating EU MS reporting in a common format whilst ensuring that the reporting requirements of the END are met. It is considered as an integral part of CNOSSOS-EU as it represents the key interface between the noise assessment throughout Europe, and the sharing of the results by means of one common noise methodological framework.

In phase B of the CNOSSOS-EU process (steps 6 to 7) a series of technical tools are in development which will help the practical implementation of CNOSSOS-EU in the EU MS. These include: structure design and creation of the CNOSSOS-EU set of input values for road, rail and industrial sources; implementation of the CNOSSOS-EU using open source software for testing purposes (road, rail and industrial noise); development

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