
Zunanji zrak - Določitev in uporaba ciljev kakovosti modeliranja za oceno kakovosti zraka

Ambient air - Definition and use of modelling quality objectives for air quality assessment

Außenluft - Definition und Verwendung von Modellierungsqualitätszielen für die Beurteilung der Luftqualität

Air ambiant - Définition et utilisation des objectifs de la qualité des modélisations pour l'évaluation de la qualité de l'air

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**Ambient air - Definition and use of modelling quality
objectives for air quality assessment**

Air ambiant - Définition et utilisation des objectifs de la
qualité des modélisations pour l'évaluation de la
qualité de l'air

Außenluft - Definition und Verwendung von
Modellierungsqualitätszielen für die Beurteilung der
Luftqualität

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European foreword

This document (CEN/TS 18275:2026) has been prepared by Technical Committee CEN/TC 264 “Air quality”, the secretariat of which is held by DIN.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

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1 Scope

This document defines and describes the methodology to calculate Modelling Quality Indicators (MQI) and determine fulfilment of the Modelling Quality Objectives (MQO). MQO are provided to help ensure that modelling-based assessments of air quality in the context of the ambient air quality directive [1] are objective and comparable, and of sufficient quality to obtain reliable information about concentrations of air pollutants in ambient air. The method uses measurement uncertainty and a level of stringency as a benchmark for the acceptable level of difference between modelled and measured values.

This document concerns the performance of an entire modelling system therefore the term “modelling quality objectives” is used rather than “model quality objectives”. This document concerns the use of modelling results for assessment as specified in [2]. Such modelling systems aim to capture both the spatial and temporal variability of the environmental indicator under assessment in the modelling domain. This document establishes a method to determine if the results of a modelling system fulfil the MQO and therefore reach an adequate data quality level within the modelling domain defined for assessment.

The procedures described in this document are limited in scope as they concern only statistical performance indicators. A full evaluation of a modelling system considers additional elements of quality assurance, but such procedures are outside the scope of this document.

This document only addresses modelling applications where measurements of pollutant concentrations are available that meet the data requirements for the validation defined in this document. This document specifies MQO that are applicable to all concentration ranges that may occur in ambient air. In the context of this document, MQI and MQO are specified for:

- daily and annual averaged concentrations of particulate matter with aerodynamic diameter less or equal to 2,5 μm ($\text{PM}_{2.5}$);
- daily and annual averaged concentrations of particulate matter with aerodynamic diameter less or equal to 10 μm (PM_{10});
- hourly, daily and annual averaged concentrations of nitrogen dioxide (NO_2);
- maximum daily 8-hour mean and seasonal averaged concentrations of ozone (O_3);
- hourly, daily and annual averaged concentrations of sulphur dioxide (SO_2);
- maximum daily 8-hour mean and daily averaged concentrations for carbon monoxide (CO);
- annual averaged concentrations for benzene (C_6H_6);
- annual averaged concentrations for lead (Pb);
- annual averaged concentrations for arsenic (As);
- annual averaged concentrations for cadmium (Cd);
- annual averaged concentrations for nickel (Ni);
- annual averaged concentrations for benzo[a]pyrene (BaP).

This document addresses competent authorities, research institutions, consultants, or other bodies responsible for the performance of air quality modelling when applied for assessment purposes.

NOTE Fulfilment of MQO is either normative or informative, depending on the quality of information used to determine the uncertainty parameters and stringency factors set out in this document.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp/>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 assessment

application of a *modelling system* (3.10) to calculate levels of ambient air quality retrospectively over a calendar year

Note 1 to entry: When modelling-based assessments of air quality are carried out in the context of [1], then assessment is defined as in [1], except that [1] has a wider scope and includes any method used to measure, calculate, predict or estimate levels. Within this document, the scope is limited to modelling.

3.2 competent authority

authority responsible for the air quality assessment

Note 1 to entry: When modelling-based assessments of air quality are carried out in the context of [1], then the competent authority is the national authority who has been designated responsible for air quality assessment in the Member State.

3.3 data coverage

proportion of the calendar year for which valid measurement data are available, expressed as percentage

Note 1 to entry: When modelling-based assessments of air quality are carried out in the context of [1], then the requirements for data coverage are those found in [1].

3.4 fixed measurements

measurements taken at *sampling points* (3.15), either continuously or by random sampling, at constant locations for at least 1 calendar year to determine the levels of ambient air quality

Note 1 to entry: When modelling-based assessments of air quality are carried out in the context of [1], then the requirements in terms of data quality objectives for fixed measurements are those found in [1].

3.5 indicative measurements

measurements, taken either at regular intervals during a calendar year or by random sampling, to determine the levels of ambient air quality in accordance with quality criteria that are less strict than those required for *fixed measurements* (3.4)

Note 1 to entry: When modelling-based assessments of air quality are carried out in the context of [1], then the requirements in terms of data quality objectives for indicative measurements are those found in [1].

3.6**modelling application**

modelling results obtained with a *modelling system* (3.10) over a given *modelling domain* (3.7), over a given time period

3.7**modelling domain**

geographic area covered by a *modelling system* (3.10) for *assessment* (3.1)

3.8**modelling quality indicator****MQI**

statistical indicator for *modelling validation* (3.11) calculated on the basis of measurement and modelling results

Note 1 to entry: The MQI describes the difference between measurements and modelling results, normalized by measurement uncertainty and a stringency factor.

3.9**modelling quality objective****MQO**

criterion for *modelling validation* (3.11) that values of the MQI should fulfil

3.10**modelling system**

chain of models and sub-models, including all necessary input data, and any post-processing

3.11**modelling validation**

comparison of modelling results against measured data, using MQI indicators

Note 1 to entry: When validating air quality *modelling applications* (3.6), this typically implies a wider range of statistical indicators. However, in this document, validation of a *modelling application* (3.6) is limited to the use of MQI indicators and fulfilment of the MQO.

3.12**maximum measurement uncertainty**

maximum accepted scatter of the measured values around the true value that is attributed to the measurement of a pollutant

Note 1 to entry: In this document, we use expanded uncertainties expressed at a 95 % confidence level. This corresponds to the *maximum measurement uncertainty* (3.12) as specified in [1].

3.13**maximum modelling uncertainty**

maximum accepted scatter of the modelled values around the true value of a pollutant

Note 1 to entry: The maximum modelling uncertainty is calculated as the *maximum measurement uncertainty* (3.12) multiplied by a stringency factor.

3.14**reference value****RV**

constant value, used to define the relationship between measurement uncertainty and concentration level, for each pollutant and time average

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Note 1 to entry: RV is expressed in the same units as the concentration level of the pollutant.

3.15**sampling point**

location where sampling of a given pollutant in ambient air takes place

Note 1 to entry: Each sampling point is location-pollutant-methodology specific.

4 Symbols and abbreviations

AQUILA	European network of national Air Quality reference Laboratories
As	Arsenic (in PM ₁₀)
AR	Acceptability Range
$\alpha_{\text{short}}, \alpha_{\text{long}}$	Fraction of the maximum measurement uncertainty that is not proportional to the concentration, ranging between 0 and 1, for short- and long-term averages. It is pollutant and measurement-type specific.
$\beta_{\text{short}}, \beta_{\text{long}}$	Ratio between the maximum modelling and measurement uncertainties for short- and long-term averages. It is pollutant and measurement-type specific, and it determines the stringency of the MQO, as $\sqrt{1 + \beta^2}$. The stringency factor β corresponds to the maximum ratio of uncertainty of modelling applications as specified in [1].
BaP	Benzo[a]pyrene (in PM ₁₀)
BIAS	Difference between modelling results and measurements
Cd	Cadmium (in PM ₁₀)
CO	Carbon monoxide
CRMSE	Centred Root Mean Square Error
C ₆ H ₆	Benzene
D	Non-integer value (distance) used to calculate the value of the 90th percentile MQI
FAIRMODE	Forum for AIR quality MOdelling in Europe
GDE	Guide to the Demonstration of Equivalence
$M(t)$	Value of modelling result at time t
$\bar{M}$	Time-average of modelling results $M(t)$
MQI	Modelling Quality Indicator
MQO	Modelling Quality Objective
Ni	Nickel (in PM ₁₀)
NO ₂	Nitrogen dioxide
N_t	Number of time steps (t)
N_s	Number of available sampling points (s)
O ₃	Ozone
Pb	Lead (in PM ₁₀)

PM _{2.5}	Particulate matter which passes through a size-selective inlet as defined in the reference method for the sampling and measurement of PM _{2.5} , EN 12341 [3], with a 50 % efficiency cut-off at 2,5 µm aerodynamic diameter
PM ₁₀	Particulate matter which passes through a size-selective inlet as defined in the reference method for the sampling and measurement of PM ₁₀ , EN 12341 [3], with a 50 % efficiency cut-off at 10 µm aerodynamic diameter
$O(t)$	Value of measurement (O) result, i.e. Observation (fixed or indicative) at time t
$\bar{O}$	Time-average of measurement values $O(t)$
R	Correlation coefficient
$RMSE$	Root Mean Square Error
$RMSU_0$	Root Mean Square Uncertainty of measurement (O)
RSS	Residual Sum of Squares
RV_{short}, RV_{long}	Reference Values for short- and long-term averages
S	Sampling point
SI	Spatial performance Indicator
SO_2	Sulphur dioxide
sp	Spatial average over sampling points
σ_O, σ_M	Standard deviation of measurement (O) and modelling (M) values
TI	Temporal performance Indicator
$U_O(O(t))$ and $U_M(O(t))$	Maximum uncertainty of measurement (O) and modelling (M) at measured concentration levels at time t
U_{Or}	Maximum relative uncertainty of measurements

5 Modelling Quality Indicator (MQI) and Modelling Quality Objective (MQO)

5.1 General

The modelling quality indicator (MQI) calculation is based on a comparison of measurements $O(t)$ and modelling values $M(t)$ for a time series (or an average of measurement values $\bar{O}$ and modelling values $\bar{M}$ over a time period), divided by the maximum measurement uncertainty $U_O(O(t))$ (or an averaged $U_O(\bar{O})$) scaled by an associated level of stringency.

The main elements of the MQI, the maximum measurement uncertainty and the associated stringency level are defined and discussed in subclauses 5.2, 5.3 and 6. The minimum level of modelling quality that shall be achieved for assessment, i.e. the modelling quality objective (MQO) calculated with the MQI, is described in subclauses 5.4 and 5.5. Clause 7 reviews the requirements regarding the reliability, availability and independence of sampling points input data. Additional complementary performance validation indicators are defined in Annex H (informative), these support the visualizations of the MQI/MQO which are provided in Annex I (informative).

The MQI and associated MQO are proposed to provide stakeholders with a consistent and unbiased estimate of the quality of results of modelling systems when applied for assessment. The MQI and MQO

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are defined for both short (e.g. hourly, daily: MQI_{short}) and longer (e.g. annual, seasonal: MQI_{long}) time averages of pollutant concentrations corresponding to the time period required for assessment of a particular environmental indicator under [1]. In this document, “short” refers to hourly time averages for NO_2 and SO_2 , 8 h daily maximum time averages for O_3 , 8-hour averages for CO and daily time averages for PM_{10} and $\text{PM}_{2.5}$ whereas “long” refers to annual time averages per calendar year for NO_2 , $\text{PM}_{2.5}$, PM_{10} , SO_2 , benzene, lead, arsenic, cadmium, nickel and BaP and seasonal time averages for O_3 . For assessment, additional short-term time averages are requested in [1] for NO_2 and SO_2 ; the quality of modelling results for these pollutants can be estimated using MQI for these short-term parameters (see Table 1).

NOTE The MQI and MQO corresponding to a particular environmental indicator are either normative or informative depending on the quality of the information used to determine the uncertainty parameters and stringency factors set out in this document.

Table 1 — Overview of status of MQI/MQO by pollutants and time averages and associated annexes for the uncertainty parameters and stringency level

Pollutant	Time category	Time resolution of the data used in the MQI	Time period covered by modelling validation data	Status of the MQI/MQO for fixed measurements (Annexes)	Status of the MQI/MQO for indicative measurements (Annexes)
PM_{10}	Long	Annual	Year	Normative (A, B)	Normative (A, B)
	Short	Daily	Year	Normative (A, B)	Normative (A, B)
$\text{PM}_{2.5}$	Long	Annual	Year	Normative (A, B)	Normative (A, B)
	Short	Daily	Year	Normative (A, B)	Normative (A, B)
NO_2	Long	Annual	Year	Normative (A, B)	Normative (A, B)
	Short	Daily	Year	Informative (F)	Informative (F)
	Short	Hourly	Year	Normative (A, B)	Normative (A, B)
O_3	Long	Hourly	Season	Normative (A, B)	Normative (A, B)
	Short	Hourly	Season	Normative (A, B)	Normative (A, B)
SO_2	Long	Annual	Year	Informative (F)	Informative (F)
	Short	Daily	Year	Informative (F)	Informative (F)
	Short	Hourly	Year	Informative (F)	Informative (F)
CO	Short	Daily	Year	Informative (F)	Informative (F)
	Short	8h daily max	Year	Informative (F)	Informative (F)
Benzene	Long	Annual	Year	Informative (F)	Informative (F)
Lead	Long	Annual	Year	Informative (F)	
Arsenic	Long	Annual	Year	Informative (F)	
Cadmium	Long	Annual	Year	Informative (F)	
Nickel	Long	Annual	Year	Informative (F)	
BaP	Long	Annual	Year	Informative (F)	