Evaluation of the inter-laboratory comparison exercise for SO2, CO, O3, NO and NO2 \*(13-16 May 2019, Ispra)

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## 1. Acknowledgements

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## 2. Abstract

Within the harmonisation programme of Air Quality monitoring in Europe the European Reference Laboratory of Air Pollution (ERLAP) organises Inter-Laboratory Comparison Exercises (ILC). From the 13th to the 16th of May 2019, nine Laboratories of AQUILA (Network of European Air Quality Reference Laboratories) met for a laboratory comparison exercise in Ispra (IT) to evaluate their proficiency in the analysis of inorganic gaseous air pollutants (NO, NO2, SO2, CO and O3) covered by the European Air Quality Directive 2008/50 EC [1] and its recent amendments 2015/1480/EC [42]. The proficiency evaluation, where each participant’s bias was compared to two criteria, provides information on the current situation and capabilities to the European Commission and can be used by participants in their quality control system. On the basis of adopted criteria, 95.6% of the results reported by AQUILA laboratories were good both in terms of measured values and reported uncertainties. The rest of the results had good measured values, but the reported uncertainties were either too high (1.3%) or too small (3.1%). Based on the z’-score evaluation, no values were found to be questionable or unsatisfactory. Comparability of results among AQUILA participants at the highest generated concentration levels is satisfactory for measurements of all pollutants.

## 3. Introduction

The Directive 2008/50/EC [1] on ambient air quality and cleaner air for Europe sets a framework for a harmonised air quality assessment in Europe. One important objective of the Directive [1] is that the ambient air quality shall be assessed on the basis of common methods and criteria. It deals with the air pollutants sulphur dioxide (SO2), nitrogen dioxide (NO2) and monoxide (NO), particulate matter, lead, benzene, carbon monoxide (CO) and ozone (O3). Among others it specifies the reference methods for measurements and Data Quality Objectives (DQOs) for the accuracy of measurements. The European Commission (EC) has supported the development and publication of reference measurement methods for CO [2], SO2 [3], NO-NO2 [4] and O3 [5] as European standards. Appropriate calibration methods [6], [7] and [8] have been standardised by the International Organization for Standardization (ISO). As foreseen in the Air Quality Directive, the European Reference Laboratory of Air Pollution (ERLAP) of the Directorate for Energy, Transport and Climate at the Joint Research Centre (JRC) organises inter-laboratory comparison exercises (ILC) to assess and improve the status of comparability of measurements of National Reference Laboratories (NRL) of the Member States of the European Union. The World Health Organization Collaborating Centre for Air Quality Management and Air Pollution Control, Berlin (WHO CC) is carrying out similar activities since 1994 [9] [10], [24], [31], [35], [38] and [45] but with a view to obtaining harmonised air quality data for health related studies. Their programme integrates within the WHO EURO region, which includes public health institutes and other national institutes - especially from the Central Eastern Europe, Caucasus and countries from Central Asia. Starting in 2004, it has been decided to bring together the efforts of both the JRC-ERLAP and WHO CC and to coordinate activities as far as possible, with a view to optimise resources and improve international harmonisation. The following report deals with the ILC that took place from 4th to the 7th of June 2018 in Ispra (IT). Since 1990 ERLAP has organised ILC in order to evaluate the comparability of measurements carried out by NRLs and promote information exchange among the expert laboratories. Recently, a more systematic approach has been adopted, in agreement with the Network of National Reference Laboratories for Air Quality (AQUILA) [11], aiming to both provide an alert mechanism for the purposes of the EC legislation and support the implementation of quality schemes by NRLs. The methodology for the organisation of ILC was developed by ERLAP in collaboration with AQUILA and is described in a paper on the organisation of laboratory comparison exercises for gaseous air pollutants [12]. This evaluation scheme was adopted by AQUILA in December 2008 and is applied to all ILC since then. It contains common criteria to alert the EC on possible performance failures which do not rely solely on the uncertainty claimed by participants. The evaluation scheme implements the z’-score method [13] with the uncertainty requirements for calibration gases stated in the European standards [2], [3], [4] and [5], which are consistent with the DQOs of European Directives. According to the above-mentioned document, NRLs with an overall unsatisfactory performance in the z’-score evaluation (one unsatisfactory or two questionable results per parameter) ought to repeat their participation in the following ILC in order to demonstrate remediation measures [12]. In addition, considering that the evaluation scheme should be useful to participants for accreditation according to ISO 17025, they are requested to include their measurement uncertainty. Hence, participants’ results (measurement values and uncertainties) are compared to the assigned values applying the En–score method [13]. Beside the proficiency of participating laboratories, the repeatability and reproducibility of standardised measurement methods [14], [15] and [16] are evaluated as well. These group evaluations are useful indicators of trends in measurement quality over different ILC.

All references here []

## 4. Inter-laboratory organization

The ILC was announced in February 2018 to the members of the AQUILA network and the WHO CC representative. Registration was opened in April 2019 and closed at the end of May 2019. The participants were required to bring their own measurement instruments, data acquisition equipment and travelling standards (to be used for calibrations or checks during the ILC). The participants were invited to arrive on Monday, 13th of May 2019, for the installation of their equipment. The calibration of NOx and O3 analysers was carried out on Tuesday morning and the generation of NOx and O3 gas mixtures started at 11:00. The calibration of SO2 and CO analysers was carried out on Wednesday afternoon and the generation of CO and SO2 gas mixtures started at 20:00. The test gases generation and measurements finished on Thursday at 9:00.

### 4.1 Participants

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| --- | --- | --- | --- |
| acronim | full\_name | country\_name | code |
| EKONERG | Energy and Environmental Protection Institute | Croatia | A |
| INERIS | Institut National de lâ€™Environnement Industriel et des Risques | France | B |
| AEA | RICARDO-AEA Technology | United Kingdom | C |
| EEA | Executive Environmental Agency | Bulgaria | D |
| CHMI | Czech Hydrometereological Institute | Czech Republic | E |
| DHZ-CAL | Meteorological and Hydrological Service - CALIBRATION | Croatia | F |
| ERLAP | European Reference Laboratory for Air Pollution | Italy | G |
| DHZ-TES | Meteorological and Hydrological Service - TEST | Croatia | H |

All participants were organisations dealing with the routine ambient air monitoring or institutions involved in environmental or public health protection. The national representatives came from Croatia, France, United Kingdom, Bulgaria, Czech Republic, Croatia, Italy, Croatia. Table 2 reports the manufacturer and model of the instrumentation used by every participant during the inter-laboratory comparison exercise including those used in the calculation of the assigned values. The instrumentation used to analyse all parameters was manufactured by three different companies. The list contains the information reported by participants and cannot be considered as an implicit or explicit endorsement by the organisers of any specific instrumentation.

Table 2: List of instruments used by participants.