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Data quality 1998, quality assurance, and field comparisons

Wenche Aas, Anne-Gunn Hjellbrekke and Jan Schaug

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EMEP Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe

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Summary

The aim of quality assurance (QA) is to provide data with sufficiently good and known data quality. This report focuses on the quality of the EMEP measurements during 1998. The report presents QA information partly collected from the participating laboratories; further, results form laboratory and field comparisons are included. Based on all this information the quality of the monitoring data is estimated.

All participating countries, except two, had a complete measurement programmes for the main components in precipitation in 1998. Most sites had also satisfactory completeness, defined as 90 per cent of the daily values during 1998. For the air components, the completeness was less satisfactory. The main problem was that the number of sites with measurements of the nitrogen components was far too low. The importance of nitrogen compounds has increased and therefore more sites with such measurements are strongly needed.

Calculations of ion balances in precipitation samples give important information on the data quality, but ion balances in samples with pH above 5 - 6 often reveal a systematic deficit of anions. This is a general problem, not only in EMEP but also at sites from networks in other parts of the world. It has been speculated in super-saturation of carbon dioxide, biological degrading, and missing organic compounds, but the causes of the apparent pH dependent systematic anion deficit is not yet understood. In EMEP this is seen at many sites e.g. in Switzerland, France, United Kingdom, Ireland, Norway. In other countries e.g. in Denmark and Russia the systematic anion deficit does not occur.

Field comparisons have so far been performed in United Kingdom, Ireland, Portugal France, Germany, Poland and Czech Republic. The field comparison in Košetice (the Czech Rep.) is evaluated in this report. The SO_2 comparison gives a 38% difference in the average concentrations, which is not satisfactory. For NO_2 larger problems are seen, with differences of more than 50% and a large spread in the results. We suggest to change the NO_2 method at Košetice from the currently used to the EMEP recommended NaI method. For airborne SO_4 the methods were generally in fairly good agreement with a difference in the order of 14%. The measurements of the sum of nitrates in air were in the first sampling period biased with a large systematic error, but were satisfactory during the last period with a difference 10-15%. In Košetice comparison of precipitation measurements was also performed, the results indicating that daily sampling by a bulk collector and weekly sampling by wet-only collector give comparable annual averages.

A main experience from the field comparisons performed so far is that the use of reference methods clearly give better results than other methods applied at the concentration levels at EMEP sites, e.g. H_2O_2 absorption for SO_2 sampling tends to give too high SO_2 concentration compared with the reference method.

Information about the calibration routines, and similar information, of the ozone monitors has been collected to obtain a picture of the data quality of the ozone measurements. Generally, the calibration routines are satisfactory at all stations.

Field and laboratory comparisons together with information of ion balance have been used to estimate and classify the different sites into four quality groups. Generally the quality is satisfactory and 66% of the data averages have been classified as “A” data indicating an expected error of 10 % or less. 23% of the averages are classified as “B” with an expected error of 25% or better. Precipitation data generally have a better quality than air measurements. This classification of data was also performed last year for the 1997 annual averages, there are only minor changes from 1997 to 1998 due to variations in the intercalibration results.

Data quality 1998, quality assurance, and field comparisons

1. Introduction

The aim of quality assurance is to provide data with sufficiently good and known quality, and this series of reports is intended to document the EMEP data quality and the progress made. The present report is relevant for the 1998 data.

Parts of the information given here is collected from the participating laboratories, this being data on detection limits and precision. Information about the calibration routines etc. of the ozone monitors have also been collected in order to obtain a picture of the quality of the ozone measurements. No laboratory comparison was carried out in 1998, however information from the WMO/GAW intercomparison in 1998 was available and used for estimating the data quality. The laboratory comparison documents the participating laboratories' ability to perform precise chemical analysis, but do not necessarily give the correct picture for routine work. The recommended measurement methods in EMEP have been described in manuals (EMEP, 1977, 1996); nevertheless, many participants apply other methods. This has created a need for estimating the differences between measurements carried out in different countries, and results from field comparisons with reference instrumentation are also given here. Calculation of ion balances in precipitation samples is important supplements to the organised comparisons.

2. Measurement programme and data completeness

Since the start in 1978, all air and precipitation measurements have been daily with the exception of ozone where hourly averages are stored. EMEP's measurement programme in 1998 is given in Table 1. Measurement period and frequency are also different for VOC, but these measurements are discussed in a separate EMEP report (Solberg, 1999).

There are a few sites with weekly precipitation sampling (SE05, SE11, SE12, DK08, CZ01 and LT15). All participating countries, except Iceland and Lithuania had complete measurement programmes for the main components in precipitation in 1998. The data completeness should be at least 90 per cent of the daily values (Annex 1) and as seen from Table 2 this requirement was broadly met by most participants for the precipitation components. Two sites (NO15 and NO55) had unsatisfactory completeness for the precipitation data during 1998. In addition, two months of the precipitation data at IT04 are flagged as invalid in the database because of poor data quality.

Table 1: EMEP's measurement programme for 1998.

	Components	Measurement period	Measurement frequency
Gas	SO_2, NO_2 O_3 Light hydrocarbons C_2-C_7* ketones and aldehydes (VOC)	24 hours Hourly means stored 10-15 minutes 8 hours	Daily Continuously Twice weekly Twice weekly
Particles	SO_4^{2-}	24 hours	Daily
Gas + particles	HNO_3 (g) + NO_3^- (p) NH_3 (g) + NH_4^+ (p)	24 hours	Daily
Precipitation	Amount of precipitation, SO_4^{2-}, NO_3^-, Cl^-, pH/H^+ NH_4^+, Na^+ Mg^{2+}, Ca^{2+}, K^+, conductivity	24 hours	Daily

* Measurements made at a small number of sites only

During 1998 available data on heavy metal and POP measurements have been collected and reported separately.

For the air component the completeness is less satisfactory. The main problem is evident from Table 3; the number of sites providing measurements of the nitrogen components is far too low. Monitoring of nitrogen components is becoming increasingly important since the large reduction of sulphur dioxide emissions in Europe has increased the relative importance of nitrogen components as acidifying agents. Furthermore, nitrogen compounds do not only contribute to the acidification and eutrophication of ecosystems but are precursors of tropospheric ozone and they contribute to the total particulate matter. Therefore it is highly desirable that more sites start measuring all the nitrogen components.

It is well known that filter packs normally will give biased results for NO_3^-, HNO_3, NH_4^+ and NH_3 due to chemical reactions and loss of volatile substances from the aerosol filter. This is followed by a corresponding increase of substance on the impregnated filter. The concentrations of the individual components should therefore be used critically. In Table 3 there are several countries reporting the individual concentration; however only sites in Hungary, Netherlands and Italy use denuders where separation of gas and particle is possible. Even though denuders are a demanding sampling equipment, it is desirable that more sites use denuders to separate particle and gas components.

Table 2: Completeness for precipitation components, 1998.

Code	mm	mm off	SO4	NH4	NO3	Na	Mg	Cl	Ca	pH	H^+ titr.	K	cond
AT02	100.0	-	99.7	99.7	99.7	99.7	99.7	99.7	99.7	100.0	-	99.7	99.7
AT04	100.0	-	99.7	98.6	99.7	99.5	99.5	99.7	99.5	100.0	-	99.5	99.6
AT05	100.0	-	99.4	98.2	99.4	99.3	99.3	99.4	99.3	100.0	-	96.2	99.6
CH02	99.7	-	98.9	98.9	98.9	98.6	98.6	98.9	98.5	99.5	-	97.2	99.5
CH03	99.7	-	98.1	98.1	98.1	95.5	98.1	98.1	97.1	98.9	-	96.3	98.9
CH04	99.7	-	98.6	98.6	98.6	98.6	98.6	98.6	98.6	99.4	-	98.6	99.4
CH05	99.7	-	98.7	98.7	98.7	98.7	97.2	98.7	96.8	99.5	-	97.6	99.5
CZ01	97.8	-	95.1	95.0	95.1	95.0	95.0	95.1	95.0	98.6	-	95.0	98.6
CZ03	100.0	-	96.1	96.8	96.1	96.5	96.6	96.1	96.8	97.1	-	96.7	96.7
DE01	100.0	-	97.2	97.2	97.2	97.2	97.2	97.2	97.2	97.8	-	97.2	97.8
DE02	100.0	-	98.5	98.5	98.5	98.5	98.5	98.5	98.5	99.3	-	98.5	99.3
DE03	100.0	-	98.4	98.4	98.4	98.4	98.4	98.4	98.4	98.7	-	98.4	98.7
DE04	100.0	-	99.4	99.4	99.4	99.4	99.4	99.4	99.4	98.9	-	99.4	99.1
DE05	100.0	-	99.5	99.5	99.5	99.5	99.5	99.5	99.5	99.8	-	99.5	99.8
DE07	100.0	-	98.0	98.0	98.0	97.9	97.9	98.0	97.9	98.9	-	97.9	99.4
DE08	100.0	-	98.7	98.6	98.7	98.6	98.6	98.7	98.6	98.7	-	98.6	98.7
DE09	100.0	-	99.1	99.0	99.1	99.0	99.0	99.1	99.0	99.5	-	99.0	99.5
DK03	100.0	-	99.2	98.2	99.2	97.0	93.4	98.1	95.7	96.5	-	97.2	96.7
DK05	100.0	-	99.4	96.9	99.4	96.9	97.5	97.2	97.7	90.2	-	95.7	96.0
DK08	99.7	-	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9	-	99.9	99.4
EE09	100.0	-	98.8	96.9	98.8	98.0	98.0	98.8	98.0	100.0	-	98.0	100.0
EE11	100.0	-	99.8	100.0	99.8	98.9	98.9	99.8	98.9	100.0	-	98.9	100.0
ES01	100.0	-	98.6	98.4	98.6	94.4	94.4	98.6	94.4	100.0	-	94.4	98.9
ES03	100.0	-	99.6	99.0	99.6	96.9	96.9	99.5	96.9	100.0	-	96.9	99.9
ES04	100.0	-	99.5	98.1	98.3	96.9	96.9	98.0	96.9	98.6	-	96.9	98.6
ES05	100.0	-	92.6	91.9	92.6	90.3	90.3	91.9	90.3	92.6	-	90.3	92.6
ES06	100.0	-	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	-	100.0	100.0
ES07	100.0	-	98.7	97.9	98.7	97.6	97.6	98.7	97.6	98.9	-	97.6	98.9
FI04	100.0	100.0	99.2	99.2	99.2	99.2	99.2	99.2	99.2	99.7	-	99.2	99.7
FI09	100.0	100.0	98.6	98.6	98.6	98.6	98.6	98.6	98.6	99.3	-	98.6	99.3
FI17	100.0	100.0	99.2	99.2	99.2	99.2	99.2	99.2	99.2	99.4	-	99.2	99.4
FI22	100.0	100.0	99.8	99.8	99.8	99.8	99.8	99.8	99.8	99.9	-	99.8	99.9
FR03	100.0	-	96.8	97.0	96.8	96.8	96.8	96.8	96.8	97.9	-	96.8	97.9
FR05	100.0	-	92.5	92.9	92.5	92.5	92.5	92.5	92.5	93.9	-	92.5	93.9
FR08	100.0	-	89.7	89.9	89.7	89.7	89.7	89.7	89.7	92.3	-	89.7	92.4
FR09	100.0	-	95.2	95.2	95.2	95.2	95.2	95.2	95.2	96.7	-	95.2	96.7
FR10	100.0	-	94.9	94.9	94.9	94.9	94.9	94.9	94.9	97.1	-	94.9	97.7
FR11	100.0	-	97.3	97.3	97.3	97.3	97.3	97.3	97.3	97.8	-	97.3	97.8
FR12	100.0	-	96.0	97.8	96.0	96.0	96.0	96.0	96.0	99.2	-	96.0	99.2
FR13	100.0	-	97.8	98.1	97.8	97.8	97.8	97.8	97.8	98.5	-	97.8	98.5
FR14	100.0	-	93.9	94.0	93.9	93.9	96.9	93.9	93.9	94.4	-	93.9	94.4
GB02	100.0	-	99.8	99.8	99.8	93.0	99.8	93.0	99.8	99.8	-	99.8	99.7
GB06	100.0	-	98.5	98.5	98.5	97.9	98.5	97.9	98.5	98.5	-	98.5	98.4
GB13	100.0	-	97.2	97.2	97.2	97.2	97.2	97.2	97.2	99.9	-	97.2	99.3
GB14	100.0	-	96.5	96.5	96.5	88.7	96.5	88.7	96.5	96.6	-	96.5	96.4
GB15	100.0	-	99.8	99.8	99.8	97.9	99.8	97.9	99.8	99.8	-	99.8	99.6
HU02	100.0	49.9	100.0	100.0	100.0	99.9	99.2	100.0	99.8	99.7	-	99.9	99.7
IE02	100.0	-	99.0	98.9	98.9	98.9	98.9	98.9	98.9	99.8	-	98.9	99.8
IE03	100.0	-	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.9	-	100.0	99.9
IE04	100.0	-	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	-	100.0	100.0
IS02	100.0	-	100.0	-	-	100.0	-	-	-	100.0	-	-	-
IT01	100.0	-	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	-	100.0	100.0
IT04	100.0	-	75.9	75.9	75.9	75.9	75.9	75.9	75.9	75.9	-	75.9	75.9
LT15	99.5	-	100.0	100.0	100.0	100.0	-	100.0	100.0	100.0	-	100.0	100.0

Table 2, cont.

Code	mm	mm off	SO4	NH4	NO3	Na	Mg	Cl	Ca	pH	H^+ titr.	K	cond
LV10	100.0	-	99.9	97.8	90.7	93.4	92.7	99.9	95.4	100.0	-	82.2	100.0
LV16	100.0	-	97.7	97.3	97.7	88.3	92.5	94.2	93.4	99.8	-	80.3	99.8
NL09	100.0	-	99.3	98.1	99.3	96.6	96.6	99.3	96.6	99.7	99.7	96.6	93.8
NO01	100.0	-	97.7	97.7	97.7	97.7	97.7	97.7	89.8	90.9	-	97.5	98.7
NO08	100.0	-	98.8	95.5	98.8	98.6	98.7	98.6	96.3	94.6	-	96.0	99.4
NO15	100.0	-	77.2	77.2	77.2	77.2	77.2	77.2	74.9	77.4	-	77.2	79.6
NO39	100.0	-	99.2	99.2	99.2	99.2	99.2	99.2	91.0	91.8	-	97.2	99.9
NO41	100.0	-	98.9	96.3	98.9	98.9	98.1	98.9	94.9	96.0	-	96.4	100.0
NO55	100.0	-	85.6	83.9	85.6	85.6	85.6	85.6	81.0	90.7	-	84.7	93.0
PL02	100.0	-	99.4	98.5	99.4	98.5	98.5	99.4	98.5	99.4	-	98.5	99.4
PL03	100.0	-	99.5	99.5	99.5	99.4	99.4	99.5	99.4	99.4	-	99.4	99.4
PL04	100.0	-	96.6	96.4	96.6	96.1	96.1	96.6	96.1	96.6	-	96.1	96.6
PL05	100.0	100.0	98.1	98.8	96.8	99.4	98.3	98.1	98.4	98.7	-	97.5	98.4
PT01	100.0	-	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	-	93.1	93.1
PT03	100.0	-	100.0	98.8	100.0	100.0	100.0	100.0	100.0	97.9	-	100.0	100.0
PT04	100.0	-	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	-	100.0	100.0
RU01	99.7	-	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	-	100.0	100.0
RU13	100.0	-	100.0	100.0	100.0	100.0	99.8	100.0	99.8	100.0	-	100.0	100.0
RU16	100.0	-	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	-	100.0	100.0
SE02	100.0	-	99.7	99.7	99.7	99.6	99.6	99.7	99.5	99.9	-	99.6	98.5
SE05	99.5	-	100.0	99.9	100.0	99.8	99.9	100.0	99.9	100.0	-	99.8	99.6
SE11	100.0	-	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	-	100.0	99.8
SE12	99.2	-	100.0	99.8	100.0	100.0	100.0	100.0	100.0	100.0	-	100.0	99.1
SK02	100.0	-	92.5	92.5	92.5	92.5	92.5	92.5	92.5	92.5	-	92.5	92.5
SK04	100.0	-	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	-	90.0	90.0
SK05	100.0	-	89.4	89.4	89.4	89.4	89.4	89.4	89.4	89.4	-	89.4	89.4
SK06	100.0	-	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	-	93.4	93.4
TR01	100.0	-	99.9	99.4	99.9	99.4	99.4	99.9	99.4	99.9	-	99.4	99.9
YU05	100.0	-	98.4	98.2	98.4	96.8	97.6	95.7	97.6	98.4	-	97.6	98.4
YU08	100.0	-	98.7	98.8	98.8	98.6	98.6	97.6	98.6	98.8	-	98.6	98.8

Ozone measurements was carried out at "normal" EMEP sites but also at sites designated for ozone alone or in combination with other measurements not included in EMEP's programme. The two rightmost columns in Table 3 give sites which report suspended particulate matter and soot and acidity in airborne particles, neither of which were elements of the measurements programme. Only a small number of sites have VOC measurements and this is reported separately (Solberg, 1999)

Table 3: Completeness of air components, 1998.

Code	SO2	SO4	O3	NO2	HNO3	NO3	sumNO3	NH3	NH4	sumNH3	SPM
AT02	84.7	96.4	92.9	77.5	-	-	-	-	-	-	-
AT04	44.9	-	94.3	50.1	-	-	-	-	-	-	-
AT05	41.9	-	89.2	45.2	-	-	-	-	-	-	-
CH01	94.2	92.9	-	79.2	-	-	-	-	-	-	94.0
CH02	99.5	98.6	99.1	97.5	-	-	98.6	-	-	99.2	99.2
CH03	98.1	-	98.8	99.2	-	-	-	-	-	-	93.7
CH04	98.4	-	98.7	97.3	-	-	-	-	-	-	94.8
CH05	100.0	95.6	99.5	100.0	-	-	-	-	-	-	99.5
CZ01	99.7	99.7	94.7	91.8	100.0	96.2	-	98.6	96.2	-	-
CZ03	99.2	99.2	98.8	96.7	99.5	100.0	-	100.0	100.0	-	-
DE01	98.1	99.2	87.3	98.9	-	-	-	-	-	-	95.6
DE02	96.7	100.0	95.9	98.9	-	-	-	-	-	-	95.6
DE03	100.0	100.0	87.8	99.5	-	-	-	-	-	-	95.6
DE04	100.0	100.0	94.1	100.0	-	-	-	-	-	-	99.7
DE05	94.5	99.7	96.6	100.0	-	-	-	-	-	-	98.4
DE07	99.5	100.0	96.2	100.0	-	-	-	-	-	-	99.2
DE08	99.7	99.7	96.7	99.2	-	-	-	-	-	-	98.9
DE09	99.7	98.4	99.3	99.7	-	-	-	-	-	-	99.2
DE11	-	-	46.4	-	-	-	-	-	-	-	-
DE12	-	-	91.2	-	-	-	-	-	-	-	-
DE14	-	-	55.2	-	-	-	-	-	-	-	-
DE17	-	-	95.4	-	-	-	-	-	-	-	-
DE26	-	-	93.5	-	-	-	-	-	-	-	-
DE31	-	-	91.0	-	-	-	-	-	-	-	-
DE35	-	-	91.0	-	-	-	-	-	-	-	-
DE38	-	-	97.8	-	-	-	-	-	-	-	-
DK03	100.0	99.7	-	-	-	-	100.0	-	-	100.0	-
DK05	99.5	100.0	-	-	-	-	100.0	-	-	99.5	-
DK08	98.6	98.4	-	90.1	-	-	98.6	-	-	98.4	-
DK31	-	-	97.2	-	-	-	-	-	-	-	-
DK32	-	-	93.3	-	-	-	-	-	-	-	-
EE09	-	-	58.5	99.2	-	-	-	-	-	-	-
EE11	54.0	-	96.3	97.3	-	-	-	-	-	-	-
ES01	98.6	92.9	-	97.3	-	-	99.2	-	91.8	97.0	92.1
ES03	94.2	94.0	-	86.6	-	-	72.9	-	93.7	95.9	94.0
ES04	91.8	87.1	-	95.3	-	-	94.8	-	87.1	72.6	84.4
ES05	74.0	64.4	-	70.1	-	-	74.8	-	64.4	69.0	63.8
ES06	91.2	95.1	-	93.4	-	-	61.1	-	95.1	92.1	64.4
ES07	94.5	79.7	-	98.9	-	-	79.7	-	79.7	91.8	79.7
FI09	98.9	99.2	98.3	100.0	-	-	98.9	-	-	99.2	-
FI17	98.1	99.7	96.7	95.3	-	-	98.1	-	-	99.2	-
FI22	98.6	98.6	95.7	85.8	-	-	98.6	-	-	99.5	-
FI37	98.6	98.9	95.1	92.6	-	-	98.6	-	-	99.2	-
FR03	100.0	99.7	-	-	-	-	-	-	-	-	-
FR05	100.0	100.0	-	-	-	-	-	-	-	-	-
FR08	100.0	100.0	95.0	-	-	-	-	-	-	-	-
FR09	100.0	100.0	93.7	-	-	-	-	-	-	-	-
FR10	99.7	100.0	-	-	-	-	-	-	-	-	-
FR11	24.7	24.7	20.5	-	-	-	-	-	-	-	-
FR12	98.1	99.7	-	-	-	-	-	-	-	-	-
FR13	100.0	100.0	74.0	-	-	-	-	-	-	-	-
FR14	75.3	75.3	88.0	-	-	-	-	-	-	-	-
GB02	99.7	99.7	96.3	-	-	-	98.6	-	-	99.2	-
GB04	98.9	99.5	-	-	-	-	-	-	-	-	-
GB06	89.3	95.6	94.6	-	-	-	-	-	-	-	-
GB07	91.8	91.5	-	-	-	-	-	-	-	-	-
GB13	82.2	91.5	86.4	-	-	-	-	-	-	-	-
GB14	99.5	99.5	98.0	-	-	-	97.0	-	-	95.3	-
GB15	94.2	91.5	87.2	-	-	-	-	-	-	-	-

Table 3, cont.

Code	SO2	SO4	O3	NO2	HNO3	NO3	sumNO3	NH3	NH4	sumNH3	SPM
GB16	98.1	98.1	-	-	-	-	-	-	-	-	-
GB31	-	-	94.1	-	-	-	-	-	-	-	-
GB32	-	-	97.4	-	-	-	-	-	-	-	-
GB33	-	-	98.2	-	-	-	-	-	-	-	-
GB34	-	-	91.6	-	-	-	-	-	-	-	-
GB35	-	-	93.4	-	-	-	-	-	-	-	-
GB36	-	-	95.5	77.5	-	-	-	-	-	-	-
GB37	-	-	94.6	94.0	-	-	-	-	-	-	-
GB38	-	-	87.3	78.1	-	-	-	-	-	-	-
GB39	-	-	96.5	-	-	-	-	-	-	-	-
GB43	-	-	89.5	74.5	-	-	-	-	-	-	-
GB44	-	-	95.4	-	-	-	-	-	-	-	-
GB45	-	-	95.0	88.5	-	-	-	-	-	-	-
HU02	90.1	92.6	97.8	99.7	-	-	90.1	92.6	92.6	-	-
IE02	100.0	99.7	-	-	-	-	-	-	-	-	-
IE03	98.1	100.0	-	-	-	-	-	-	-	-	-
IE04	66.6	98.6	-	-	-	-	-	-	-	-	-
IE31	-	-	97.0	-	-	-	-	-	-	-	-
IS02	-	98.1	-	-	-	-	-	-	-	-	-
IT01	95.9	95.9	94.0	84.7	95.9	95.9	-	95.9	95.9	-	-
IT04	100.0	100.0	100.0	100.0	-	100.0	-	-	100.0	-	100.0
LT15	98.9	99.7	96.4	89.6	-	100.0	98.9	-	99.5	97.3	-
LV10	97.0	95.1	91.9	98.4	-	98.1	96.4	-	98.1	96.2	-
LV16	80.3	88.2	-	89.0	-	86.6	82.2	-	88.5	88.5	-
NL09	87.1	98.9	99.6	100.0	-	98.9	-	-	98.9	-	-
NL10	87.1	99.5	92.4	91.5	-	99.5	-	76.2	99.5	-	-
NO01	93.4	93.4	99.3	99.2	-	-	91.2	-	-	93.2	-
NO08	98.1	97.5	-	99.7	-	-	95.6	-	-	98.1	-
NO15	95.6	97.5	99.8	98.9	-	-	95.6	-	-	97.5	-
NO39	98.9	98.6	99.4	99.7	-	-	98.6	-	-	94.8	-
NO41	99.5	99.5	99.9	98.1	-	-	97.5	-	-	99.5	-
NO42	89.6	89.6	99.3	-	-	-	89.6	-	-	88.2	-
NO43	-	-	99.9	-	-	-	-	-	-	-	-
NO45	-	-	99.9	-	-	-	-	-	-	-	-
NO48	-	-	97.0	-	-	-	-	-	-	-	-
NO52	-	-	93.9	-	-	-	-	-	-	-	-
NO55	93.2	95.6	98.5	97.5	-	-	92.1	-	-	95.6	-
NO56	-	-	99.4	-	-	-	-	-	-	-	-
PL02	90.7	90.7	96.8	97.5	-	90.4	99.2	-	90.7	99.2	99.2
PL03	98.1	98.1	72.5	98.1	-	98.1	98.1	-	98.1	90.1	98.1
PL04	98.1	96.7	98.4	96.7	-	97.8	98.1	-	98.1	98.1	98.1
PL05	98.1	98.6	96.2	97.5	-	-	94.0	-	-	97.5	-
RU01	78.4	78.4	-	-	-	78.4	-	-	78.4	78.4	-
RU13	31.8	31.8	-	-	-	31.8	-	-	31.8	-	-
RU16	83.8	83.8	-	-	-	83.8	-	-	83.8	-	-
SE02	93.2	93.7	98.9	99.2	-	-	92.9	-	-	92.9	98.6
SE05	99.7	99.7	-	100.0	-	-	99.7	-	-	99.7	100.0
SE08	96.4	96.4	-	97.3	-	-	-	-	-	-	98.9
SE11	89.6	89.6	98.8	91.5	-	-	89.3	-	-	89.0	92.6
SE12	95.3	94.5	97.4	99.2	-	-	94.2	-	-	94.0	-
SE13	-	-	99.5	-	-	-	-	-	-	-	-
SE32	-	-	99.8	-	-	-	-	-	-	-	-
SE35	-	-	99.7	-	-	-	-	-	-	-	-
SI08	98.4	98.4	90.1	-	-	-	98.4	-	-	98.4	-
SI31	-	-	88.8	-	-	-	-	-	-	-	-
SI32	-	-	89.7	-	-	-	-	-	-	-	-
SI33	-	-	87.8	-	-	-	-	-	-	-	-

Table 3, cont.

Code	SO2	SO4	O3	NO2	HNO3	NO3	sumNO3	NH3	NH4	sumNH3	SPM
SK02	99.5	99.5	52.2	96.2	99.5	99.5	-	-	-	-	-
SK04	99.2	98.9	66.3	100.0	99.2	99.2	-	-	-	-	-
SK05	74.2	74.0	-	99.5	74.2	74.0	-	-	-	-	-
SK06	99.2	97.8	67.9	99.7	99.2	97.8	-	-	-	-	-
TR01	59.5	55.9	-	60.3	59.5	56.2	56.4	60.3	60.3	60.3	-
YU05	75.3	-	-	94.8	-	-	-	-	-	-	-
YU08	98.4	-	-	95.9	-	-	-	-	-	-	

3. Ion balances

The ion balance is a good test on consistency and errors in the analytical results, but will not necessarily reveal a contamination of the sample. This will depend on whether or not the contamination occurred before the analysis started. The ion balance will also fail to discover errors related to the precipitation sampling.

The ion balances for all precipitation samples from 1998 are presented in Annex 2, as a function of pH. Ion balances for samples with pH < 5 were, for many countries, better than 15–20%, indicating fairly good accuracy in the determination of the individual ions. Highly consistent results were e.g. given by Denmark and Russian Federation. It is also clearly seen from Annex 2 that there were laboratories that report data with unsatisfactory ion balances.

At some sites there were many samples with pH > 5. This is particularly the case in Mediterranean countries due to alkaline dust as clearly seen from the Portuguese and Spanish results, as well as at other continental sites and in the far north of Europe. It is an experience made that ion balances become markedly poorer with increasing pH above 5–6. Some countries seem to have systematic deficit of anions, i.e. in contrast to the large spread in the ion balances seen in the Mediterranean. This is seen at many sites, e.g. in Switzerland, France, United Kingdom, Ireland and Norway. In other countries e.g. in Denmark and Russia the systematic anion deficit does not occur.

The precise reason for the poor ion balances at pH values above 5–6 is not clear. One contributing factor is certainly due to unmeasured ion species present in the sample, i.e. organic acids and bicarbonate. Biological degradation of some precipitation components may also contribute. The systematic deficit of anions at pH above 5–6 is a general problem which also occur in other networks in other parts of the world. The current situation with the very poor ion balances for samples with pH above 5 is highly unsatisfactory since we will only have limited information about the consistency of these results. Countries having weakly acidic samples as a larger fraction of their precipitation could supplement their current pH measurements with titration for determining weak acid concentrations, preferably as described in the Manual (EMEP, 1996). Only two sites do this today, Hungary and Netherlands, Table 2.

4. Accuracy, detection limits and precision

It is in principle not possible to determine the accuracy of air and precipitation measurements if accuracy is defined as deviation from the true concentration. The closest one gets is by doing field comparisons; results of that are summarised later in Chapter 5.

A request for quality assurance data was made earlier this year: measurement and laboratory lower detection limit and precision, results from control samples, and detection limits and precision for monitors. The information collected on detection limits and precision is given in Annex 3.

5. Results from the field comparisons

5.1 Introduction

Since many countries still use methods which deviate from the recommended ones for measurements of sulphur dioxide, nitrogen dioxide and sulphate concentrations in air, it is of particular interest to see if the use of these methods lead to systematic differences in the reported concentrations. This need to quantify the accuracy of the EMEP measurements initiated the field comparisons at EMEP sites. Field comparisons have so far been done in United Kingdom, Ireland, Portugal France, Germany, Poland and the Czech Republic, and most of the results from these were reported in the last years data quality reports (Schaug et al., 1998; Aas et al, 1999). The complete results from the comparison in the Czech Republic are presented here.

A co-located measurement with reference instrumentation is a very direct method for determining the actual quality of the routinely reported EMEP data. It has been found most informative to carry out the comparisons at one site in each country, using a set of reference instruments, which correspond to the specifications in the EMEP Manual. An inherent advantage of the reference methods is that the samples are stable and may be mailed from one country to another without any deterioration or change of concentrations. In order to make the comparison valid for a representative period, it was also decided to distribute the comparison measurements over a whole year and about 100 measurements were considered necessary. The reference samples were collected two days every week, or in some cases during one week every month of practical reasons.

To compare the two methods, different statistical calculations can be used. The systematic difference between two measurement series is usually described by the median of the differences between the sample pairs. For comparison of mean values, the mean difference may be more useful. The modified median absolute deviation (M.MAD) is a non-parametric measure of the spread difference between corresponding daily results from two samplers. The M.MAD becomes identical to the standard deviation if the differences have a normal distribution (Sirois and Vet, 1994). Previous field comparison (Schaug et al., 1998) showed clearly that the errors in sampling and chemical analysis are small when the samples are collected with identical equipment and analysed at the same laboratory.

Deviations between the average concentrations obtained from the analyses are mostly caused by a few (1–2) outlier values. These outlier values do not influence the modified median absolute deviation, which in all cases was well below 10% of the average concentrations.

5.2 Reference instrumentation

The EMEP manual recommends a filterpack method with an aerosol filter for collection of sulphate, and subsequent absorption of sulphur dioxide on a cellulose filter impregnated with KOH. This filterpack is also suitable for determining the sum of nitrate aerosol and gaseous nitric acid. Evaporation of ammonium nitrate collected on the aerosol filter during the sampling period will lead to nitric acid that is collected on the impregnated filter. The quantity of nitrate accumulated on the impregnated filter will therefore usually represent an overestimate of the airborne gaseous nitric acid.

For nitrogen dioxide, the recommended sampling method is conversion to nitrite, using sodium iodide as an electron donor and absorbing agent. In order to achieve good sensitivity and low detection limits, sodium iodide is added to glass sinter frits, contained in glass bulbs which can be stoppered. Cleaning and impregnation of these sampling devices is carried out in the laboratory, after which the glass frits are exposed at the sampling site and returned to the laboratory for chemical analysis. The sampler used is a sequential air sampler, which collects eight 24-h samples sequentially. A gas meter is used to read the total volume after exposure of 7 or 8 samples. The methods are described in more detail in the EMEP Manual for Sampling and Chemical Analysis (EMEP, 1996).

5.3 Comparison at Košetice (CZ3)

5.3.1 Air sampling

The field comparison in Košetice started in September 1998. Preliminary results were presented last year (Aas et al., 1999) but now the complete exercise is evaluated.

SO_2 and NO_2 are sampled by both automatic and manual methods. The manual NO_2 sampling is done by a guajacol impregnated filter and analysed spectrophotometrically using NEDA and sulphanilamide (Griess reaction). The manual SO_2 sampling is performed using KOH impregnated filters and the analyses are done by the Thorin method. The automatic SO_2 and NO_2 methods are done using UV-fluorescence and chemiluminescence, respectively. The nitric acid values are not derived from the same filter as SO_2, but sampled on a NaCl impregnated filter. The nitrates are analysed using the Griess reaction

The SO_2 comparison gives a difference of 38% of the average concentrations (Table 4), which is far from satisfactory. The spread is somewhat better (30%). Figure 1 indicates that the main problem is systematic errors in the measurements. This can be due to an analytical problem using the Thorin method, the results in the laboratory intercomparison in 1997 (Hanssen et al., 1997) could indicate this. It is recommended to use ion chromatography to analyse SO_2. The comparisons with the automatic instruments gave few data,; however, a 46% difference when comparing 20 data points is rather alarming. For airborne SO_4 the methods were generally in a fairly good agreement with a difference in the order of 14%. Unfortunately there are few measurements to compare (only 39), because only one sample was measured every week in 1999.

For NO_2 larger problems are seen, with deviations of more than 50% and a large spread. We strongly recommend the method for NO_2 at Košetice to be changed to the EMEP reference NaI method. The chemiluminescence method was compared, only 24 days with the reference method during 1998s, giving too few data for a conclusion. Nevertheless, a difference of about 100% is not promising; the large discrepancy is also seen in Figure 3. The measurements of sum nitrates were in the first sampling period biased with a large systematic error. This was probably due to difficulties in correcting for the field blanks. The difference was more than 100% for the first 4 months, but the results were satisfactory during 1999 with a difference between 10–15%.

Table 4: Results of co-located sampling at Košetice. Unit: μg S(N)/m³. The SO_2 and NO_2 results are from the manual methods. For sum nitrate the comparison are done using only data from February 1999.

	Kosetice	Reference	Kosetice	Reference
	Sulphur dioxide (SO_2-S)		Nitrogen dioxide (NO_2-N)	
Average	2.18	1.57	2.50	1.61
Median	1.53	0.98	2.22	1.39
Number of sample pairs	80		75	
Average difference	-0.61		-0.89	
Median difference	-0.51		-0.69	
M.MAD	0.49		1.18	
	Sulphate aerosol (SO_4S)		Sum nitrate (NO_3^-+HNO_3)	
Average	1.24	1.09	0.60	0.65
Median	1.00	0.81	0.48	0.59
Number of sample pairs	39		38	
Average difference	0.16		-0.05	
Median difference	0.24		-0.06	
M.MAD	0.25		0.32	

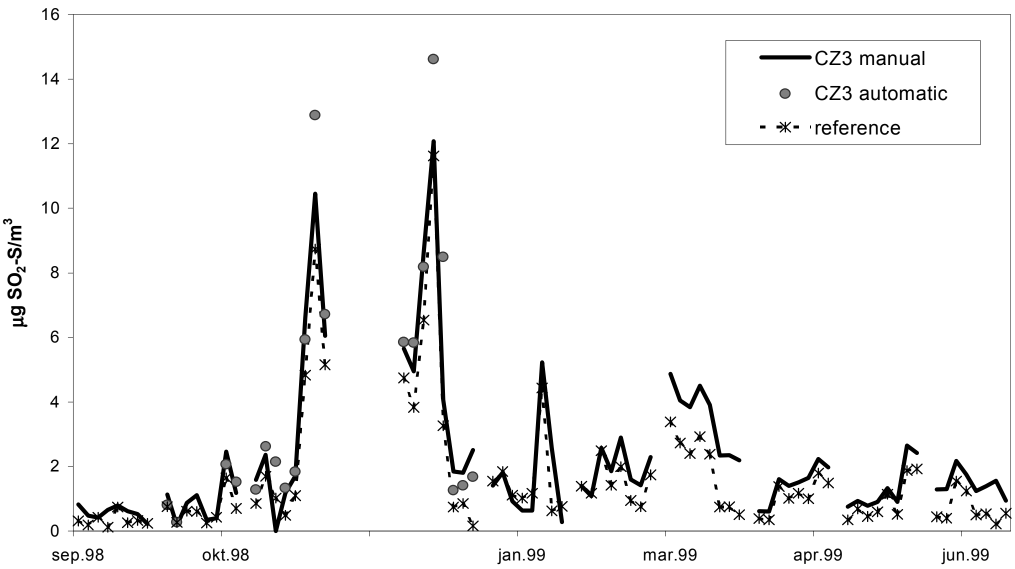

Figure 1: Comparison of measurements at Košetice with reference sampler, results for sulphur dioxide.

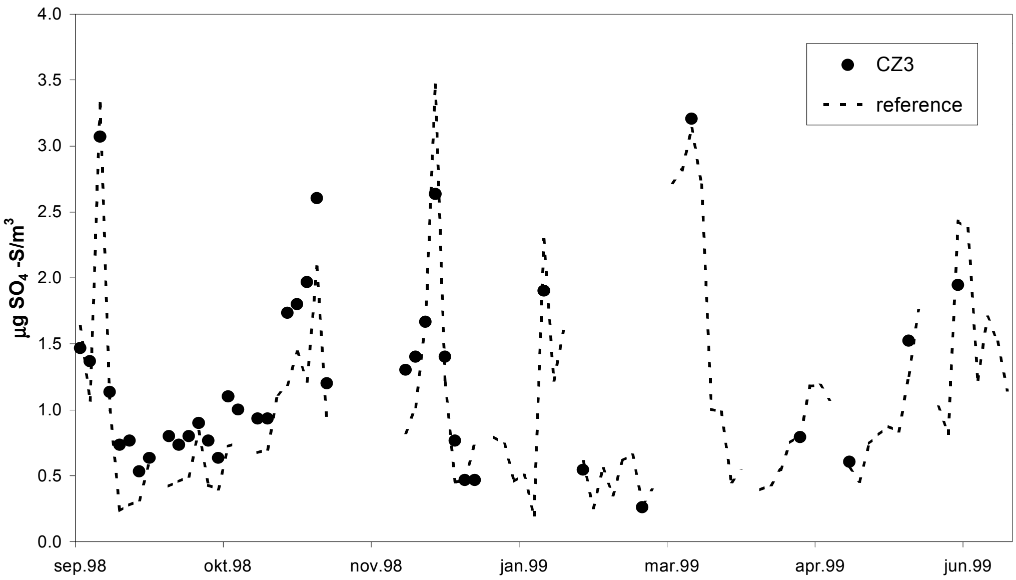

Figure 2: Comparison of measurements at Košetice with reference sampler, results for particulate sulphate.

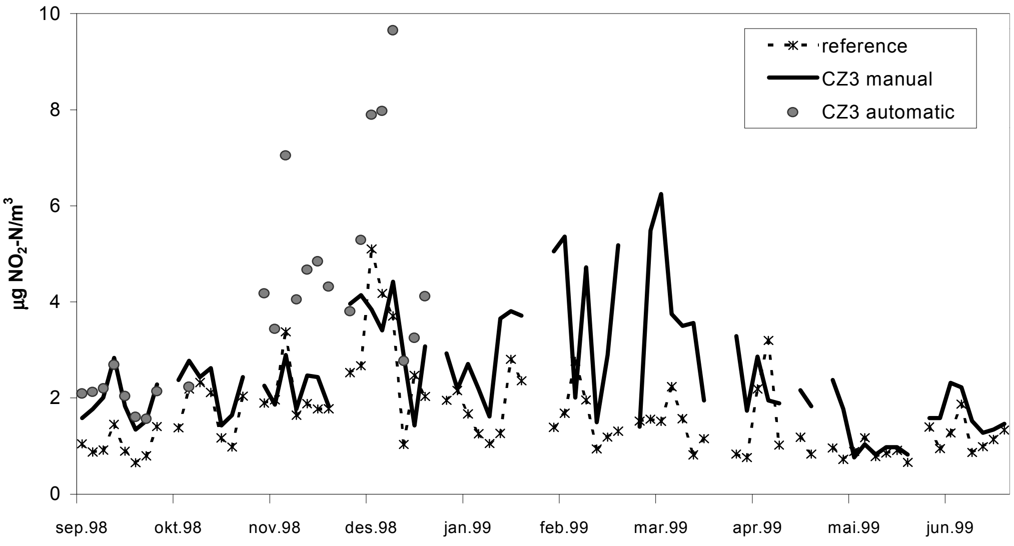

Figure 3: Comparison of measurements at Košetice with reference sampler, results for nitrogen dioxide.

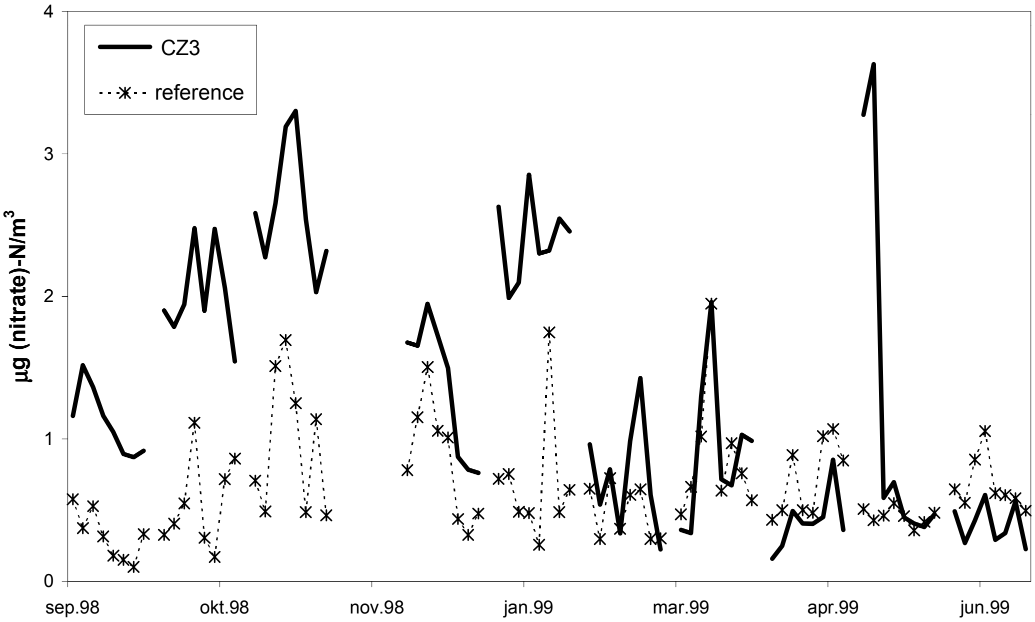

Figure 4: Comparison of measurements at Košetice with reference sampler, results for sum nitrates.

5.3.2 Precipitation sampling

In Košetice precipitation measurements were also compared. The Czech samplers were a stainless steel wet-only collector (Kos. WO) and a bulk collector. They were compared with a wet-only collector from MISU with a sampling frequency of one week. The bulk sampling had a daily frequency and the results were transformed to weighted weekly averages to compare with the MISU collector results. In weeks with sufficient precipitation amounts, the samples from the

MISU collector were analysed at both NILU and CHMI. The analytical difference is small except for sodium as seen in Table 5. The comparisons with the two Czech precipitation collectors are satisfactory as well. There are, however, rather high differences for sodium and chloride, but this is mainly caused by one outlier 16th February. The chloride concentration in the MISU collector was found to be 2.37 mg Cl^-/l compared with 0.08 mg Cl^-/l for the Kos. WO. Assuming this sample to be contaminated and this result deleted, the average of the MISU samples is reduced to 0.23 mg Cl^-/l giving a deviation of only 6%. For sodium the concentration were 1.34, 0.06 and 0.29 mg Na^+/l for MISU, Kos. WO, and bulk respectively. Deleting these concentrations the deviations are reduced to less than 10%. The pH for the bulk sampler is slightly too low. The data quality objective requires an accuracy within 0.1 unit of pH. Nevertheless, the main conclusion is that the use of either daily samples from a bulk collector or weekly using a wet-only collector at Košetice will give comparable annual averages.

Table 5: Average concentration of weekly precipitation sampling; the number of samples were for the MISU: 20, the bulk: 27 and the local wet-only: 25.

	Ref.	MISU	*dev%*	Ref.	bulk	*dev%*	Ref.	Kos. WO	*dev%*
mm	223			282	267	*5*	252	263	*4*
pH	4.61	4.64		4.59	4.44		4.61	4.51	
mg SO_4^{2-} /m^3	1.54	1.53	*1*	1.82	1.93	*6*	1.89	2.04	*8*
mg NO_3^- /m^3	2.15	2.10	*2*	2.34	2.48	*6*	2.35	2.52	*7*
mg NH_4^+ /m^3	0.47	0.47	*1*	0.56	0.63	*12*	0.61	0.70	*16*
mg Cl /m^3	0.56	0.52	*6*				0.47	0.22	*53*
mg Ca^{2+} /m^3	0.25	0.22	*11*	0.25	0.22	*10*	0.25	0.28	*8*
mg Na^+ /m^3	0.32	0.25	*21*	0.28	0.17	*40*	0.27	0.12	*54*
mg K^+ /m^3	0.08	0.05	*37*	0.08	0.11	*35*	0.07	0.07	*7*

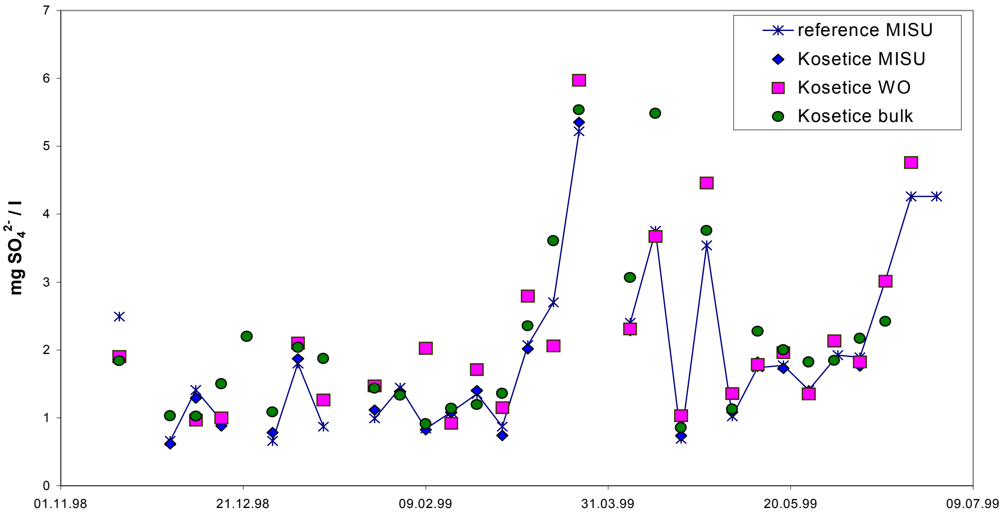

Figure 5: Comparison of measurements at Košetice with reference sampler, results for sulphate in precipitation.

5.4 Summary and preliminary conclusions

A summary of the co-located measurements carried out so far is given in Table 6. When comparing all the measurements using H_2O_2 absorption for SO_2 sampling it is quite clear that this technique tends to give too high SO_2 concentration compared with the reference method as seen in Figure 6. This has also been observed in earlier field comparisons performed in Vavihill (Semb et al., 1991).

At Schauinsland, DE3, three different SO_2 methods were compared with the reference method and the results were unsatisfactory for the UV-fluorescence and the TCM methods, but satisfactory for the recommended filterpack method, Table 6. It should be pointed out that the monitor data are not used to provide EMEP data from this station. Furthermore, Germany is now replacing their TCM measurements with the recommended method. Schauinsland is situated in a remote location in the mountains and maintenance of the equipment is therefore limited. This indicates that monitors which are not frequently calibrated and maintained give incorrect results. Even when properly maintained, UV-fluorescence is not sufficiently precise at low SO_2 concentrations resulting in unsatisfactory annual average values at remote sites. Filterpack is the only available method that so far has proven to give reliable and sensible results at the 0.1-0.2 μg-S/m^3 concentration level for sulphur dioxide. Many countries are changing or plan to change their manual methods with automatic equipment. A careful investigation with long parallel measurements is needed to ensure that the results are satisfactory.

The NaI method is recommended at background stations with low concentrations of NO_2. The samples are stable for several weeks and the method is suitable when the analysis has to be performed in a laboratory far from the sampling site. Only Jungfraujoch (CH1) applies a chemiluminescence monitor which is nearly as sensitive as the NaI method. The other monitors applied are less sensitive and are not specific for NO_2; other reducible nitrogen compounds (e.g. HNO_3 and PAN) give a positive interference, which can be a serious problem at some sites (Dechaux et al., 1991, Fähnrich et al., 1993). It may, however, be added that even the NaI method has a 20 % absorption of PAN (Ferm and Sjödin, 1993) which could give a significant contribution in the most remote parts of Europe.

The requirements with respect to data accuracy is determined by the use of data for models comparison and in connection with effect assessments.. When used in conjunction with models, the accuracy objective for the models is that the difference between the measurements and the model estimates should not exceed ±30%. This implies, taking into account the difficulties with the spatial resolution and site representativeness, that the absolute accuracy in the measurements should be better than ±10%, at least for long-term averages. Many of the measurement series satisfy this requirement, but as shown in Table 6 there are also some which fail, particularly when non-recommended methods are used.

At background sites it is particularly important that the detection limit is well below the ambient concentration levels, and that the equipment at the site is simple and robust, minimizing handling and operational errors. Simple sampling equipment, and detailed sampling procedures should be favoured over more sophisticated equipment, even if the latter could give more detailed results in the short term.

Table 6: Average of the SO_2, SO_4^{2-}, NO_3^- + HNO_3 concentrations (µg-S(N)/m^3), reference method in bold.

	GB2	IE2	PT4	FR8	DE3	PL5	CZ3
SO_2							
	0.62	**0.59**	**1.79**	**0.73**	**0.54**	**1.39**	**1.57**
filter		0.57			0.64		2.18
abs.	0.86		2.96	0.81	0.20	1.22	
monitor					1.15		
SO_4^{2-}							
	0.63	**0.85**	**1.56**	**0.82**	**0.61**	**1.24**	**1.09**
filter	0.64	0.78	1.77	0.62	0.66	1.02	1.24
NO_2							
		0.51	**0.99**		**1.00**	**0.89**	**1.61**
sinter							2.50
abs		0.65			1.13	0.94	
monitor			1.04		1.67		
Σ nitrat							
	0.44				**0.46**	**0.54**	**0.36**
filters	0.38				0.73	0.64	1.32

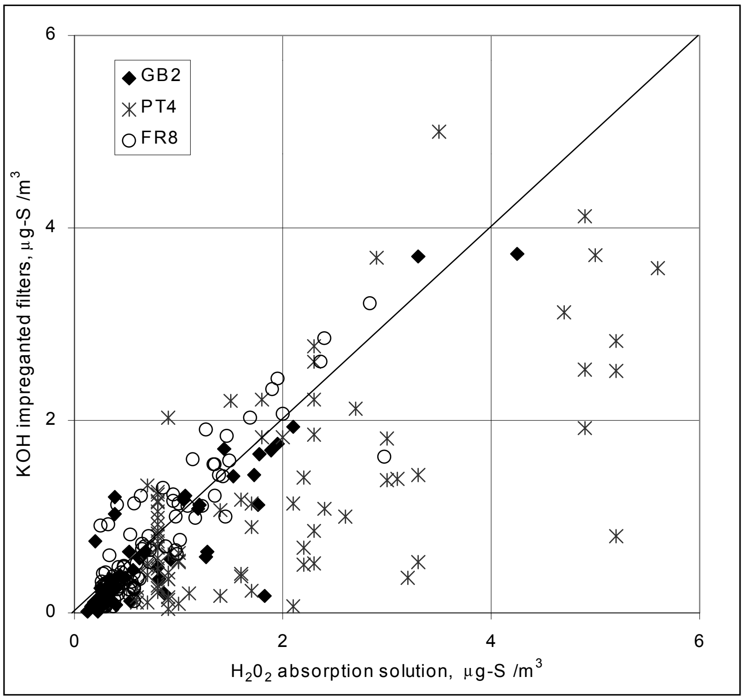

Figure 6: Comparison of SO_2 concentration in co-located measurements in Donon (FR8), Monte Velho (PT4) and Eskdalemuir (GB2) using H_2O_2 absorption solution and filterpack method using KOH impregnated filters.

6. Methods and data quality

6.1 Evaluation of monitoring network in 1998

The methods and data quality of EMEP air and precipitation measurements have been evaluated. The intention is to give an estimate of the expected errors in annual averages from 1998. The reason for this choice being that arithmetic averages are used for many purposes, e.g. comparisons between measurements and model results.

The averages have been classified in four quality groups:

A: expected error 10 % or better
B: expected error 25 % or better
C: expected error 30 % or better
D: expected error worse that 30 % or unknown/not documented

The sources that have been used in the estimates are as follows:

- 21st WMO/GAW Acid-Rain Performance Survey (Colman et al., 1999). EMEP/CCC did not have any laboratory intercomparison in 1998 and with acceptances from WMO and the participants this survey was used to obtain the most representative picture of the data quality in 1998.
- For laboratories that were not participating, information from the three previous years comparisons (Hanssen and Skjelmoen, 1995; 1996; 1997) were used.
- Results from field comparisons (Schaug et al., 1998; Aas et al., 1999).
- Calculations on ion balances.

The laboratory comparison gives information about laboratory performance. The weakness in these tests is that laboratories may put more effort into analysing the comparison samples, which arrive once every year, than in the large number of routine samples they receive every week. The comparison results may for this reason give a non-representative estimate of the accuracy. It must therefore be emphasised that the classification based on laboratory comparison not necessary reveals the absolute truth. The estimates are judged on very limited information and even good laboratories may have bad single measurements, which not necessarily results in poor yearly averages.

Field comparisons are the best way to quantify errors and differences to reference methods. As far as possible such information has been used. As a result of these comparisons, the UV spectrometry for sulphur dioxide is classified as “D” (expected error worse that 30 % or unknown). A chemiluminescence measurement of nitrogen dioxide has been classified as, “C” (expected error 30 % or better).

Data from other years than 1998 may have different qualities than that estimated below in Table 7. The classification of data was also performed for the annual averages for 1997 (Aas et al., 1999). There are only minor changes due to small variations in the intercalibration results.

Table 7: Summary of the data quality at the different stations.

Station Code and Name	amount prec	SO4 prec	H prec	pH prec	NH4 prec	NO3 prec	Na prec	Mg prec	Cl prec	Ca prec	K prec	κ prec	SO2 Air	NO2 Air	HNO3 Air	NH3 Air	SO4 Air	NO3 Air	NH4 Air	HNO3+NO3 air	NH3+NH4 Air
AT2 Illmitz		A		A	A	A	A	A	A	A	A	A	D	D			A				
AT4 St. Koloman		A		A	A	A	A	A	A	A	A	A	D	D							
AT5 Vorhegg		A		A	A	A	A	A	A	A	A	A	D	D							
CH1 Jungfraujoch													D	A			A				
CH2 Payerne		A		A	A	A	A	B	A	A	B	A	D	C			A			A	A
CH3 Taernikon		A		A	A	A	A	B	A	A	B	A	D	C							
CH4 Chaumont		A		A	A	A	A	B	A	A	B	A	D	C							
CH5 Rigi		A		A	A	A	A	B	A	A	B	A	D	C			A				
CSI Svratouch		A		A	A	A	A	A	A	B	B	A	B	C			B			B	B
CS3 Kosetice		A		A	A	A	A	A	A	B	B	A	B	C			B			B	B
DE1 Westerland		A		A	B	B	A	A	A	A	A	A	C	D			B				
DE2 Langenbruegge		A		A	B	B	A	A	A	A	A	A	C	D			B				
DE3 Schauinsland		A		A	B	B	A	A	A	A	A	A	C	D			B				
DE4 Deuselbach		A		A	B	B	A	A	A	A	A	A	C	D			B				
DE5 Brotjackriegel		A		A	B	B	A	A	A	A	A	A	C	D			B				
DE7 Neuglobsow		A		A	B	B	A	A	A	A	A	A	C	D			B				
DE8 Schmuecke		A		A	B	B	A	A	A	A	A	A	C	D			B				
DE9 Zingst		A		A	B	B	A	A	A	A	A	A	C	D			B				
DK3 Tange		A		A	A	A	A	B	A	A	B	A	A	A			A			A	A
DK5 Keldsnor		A		A	A	A	A	B	A	A	B	A	A	A			A			A	A
DK8 Anholt		A		A	A	A	A	B	A	A	B	A	A	A			A			A	A
EE9 Lahemaa		A		A	A	A	A	C	B	D	C	A		D							
EE11 Vilsandy		A		A	A	A	A	C	B	D	C	A	D	B							
ES1 San Pablo		A		A	B	A	A	A	A	A	A	A	B	B			B		D	B	B
ES3 Roquetas		A		A	B	A	A	A	A	A	A	A	B	B			B		D	B	B
ES4 Logrono		A		A	B	A	A	A	A	A	A	A	B	B			B		D	B	B

Table 7, cont.

Station Code and Name	amount prec	SO4 prec	H prec	pH prec	NH4 prec	NO3 prec	Na prec	Mg prec	Cl prec	Ca prec	K prec	κ prec	SO2 Air	NO2 Air	HNO3 Air	NH3 Air	SO4 Air	NO3 Air	NH4 Air	HNO3+NO3 air	NH3+NH4 Air
ES5 Noya		A		A	B	A	A	A	A	A	A	A	B	B			B		D	B	B
ES6 Mahon		A		A	B	A	A	A	A	A	A	A	B	B			B		D	B	B
ES7 Viznar		A		A	B	A	A	A	A	A	A	A	B	B			B		D	B	B
F14 Ahtari		A		A	A	A	A	A	A	A	A	A									
F19 Utoe		A		A	A	A	A	A	A	A	A	A	B	C			A			A	A
FI17 Virolahti		A		A	A	A	A	A	A	A	A	A	B	C			A			A	A
FI22 Oulanka		A		A	A	A	A	A	A	A	A	A	B	C			A			A	A
FI37 Ahtari													B	C			A			A	A
FR3 La Crouzille		A		A	A	A	A	A	A	A	A	A	B				B				
FR5 La Hague		A		A	A	A	A	A	A	A	A	A	B				B				
FR8 Donon		A		A	A	A	A	A	A	A	A	A	B				B				
FR9 Revin		A		A	A	A	A	A	A	A	A	A	B				B				
FR10 Morvan		A		A	A	A	A	A	A	A	A	A	B				B				
FR11 Bonnevaux		A		A	A	A	A	A	A	A	A	A	B				B				
FR12 Iraty		A		A	A	A	A	A	A	A	A	A	B				B				
FR13 Peyrusse Vieille		A		A	A	A	A	A	A	A	A	A	B				B				
FR14 Montandon		A		A	A	A	A	A	A	A	A	A	B				B				
GB2 Eskdalemuir		A		A	B	A	A	B	A	B	A	A	B				A			A	A
GB4 Stoke Ferry													B				A				
GB6 Lough Navar		A		A	B	A	A	B	A	B	A	A	B				A				
GB7 Barcombe Mills													B				A				
GB13 Yarner Wood		A		A	B	A	A	B	A	B	A	A	B				A				
GB14 High Muffles		A		A	B	A	A	B	A	B	A	A	B				A			A	A
GB15 Strath Vaich D.		A		A	B	A	A	B	A	B	A	A	B				A				
GB16 Glen Dye													B				A				
GB36 Harwell														C							
GB37 Ladybower														C							

Table 7, cont.

Station Code and Name	amount prec	SO4 prec	H prec	pH prec	NH4 prec	NO3 prec	Na prec	Mg prec	Cl prec	Ca prec	K prec	κ prec	SO2 Air	NO2 Air	HNO3 Air	NH3 Air	SO4 Air	NO3 Air	NH4 Air	HNO3+NO3 air	NH3+NH4 Air
GB38 Lullington Heath														C							
GB43 Narberth														C							
GB45 Wicken Fen														C							
HU2 K-puszta		B	A	A	B	A	B	A	B	B	B	A	A	A		B	A		B	A	
IE1 Valentia Obser.																					
IE2 Turlough Hill		A		B	A	A	A	B	B	B	B	A	B				B				
IE3 The Burren		A		B	A	A	A	B	B	B	B	A	B				B				
IE4 Ridge og Capard		A		B	A	A	A	B	B	B	B	A	B				B				
IS2 Irafoss		A		A			A						B				A				
IT1 Montelibretti		A		D	B	A	A	A	B	D	B	A	A	C	A	B	A	A	B		
IT4 Ispra		A		A	A	A	A	A	A	A	A	A	D	C			A	D	D		
LT15 Preila		A		A	A	A	A		B	A	A	B	A	B			A	D	D	A	A
LV10 Rucava		C		A	A	B	A	B	A	B	A	A	B	B			B	D	D	B	B
LV16 Zoseni		C		A	A	B	A	B	A	B	A	A	B	B			B	D	D	B	B
NL9 Kollumerwaard		A		A	A	A	A	B	A	A	B	A	D	C			A	A	A		
NL10 Vreedepeel													D	C		D	A	A	A		
NO1 Birkenes		A		A	A	B	A	A	A	A	A	A	A	A			A			A	A
NO8 Skreaadalen		A		A	A	B	A	A	A	A	A	A	A	A			A			A	A
NO15 Tustervatn		A		A	A	B	A	A	A	A	A	A	A	A			A			A	A
NO39 Kaarvatn		A		A	A	B	A	A	A	A	A	A	A	A			A			A	A
NO41 Osen		A		A	A	B	A	A	A	A	A	A	A	A			A			A	A
NO42 Spitzbergen, Z.													A				A			A	A
NO55 Karasjok		A		A	A	B	A	A	A	A	A	A	A	A			A			A	A

Table 7, cont.

Station Code and Name	amount prec	SO4 prec	H prec	pH prec	NH4 prec	NO3 prec	Na prec	Mg prec	Cl prec	Ca prec	K prec	κ prec	SO2 Air	NO2 Air	HNO3 Air	NH3 Air	SO4 Air	NO3 Air	NH4 Air	HNO3+NO3 air	NH3+NH4 Air
PL2 Jarczew		A		A	A	A	A	A	A	A	A	A	B	B			A	D	D	A	A
PL3 Sniezka		A		A	A	A	A	A	A	A	A	A	B	B			A	D	D	A	A
PL4 Leba		A		A	A	A	A	A	A	A	A	A	B	B			A	D	D	A	A
PL5 Diabla Gora		B		B	B	B	B	B	B	B	B	B	A	A			B			B	B
PT1 Braganca		A		A	A	B	C	D	A	B	D	A									
PT3 V.d. Castelo		A		A	A	B	C	D	A	B	D	A									
PT4 Monte Velho		A		A	A	B	C	D	A	B	D	A									
RU1 Janiskoski		A		A	A	A	A	A	B	D	D	B	B	A			B	D	D		B
RU13 Pinega		A		A	A	A	A	A	B	D	D	B	B	A			B	D	D		
RU16 Shepeljovo		A		A	A	A	A	A	B	D	D	B	B	A			B	D	D		
SE2 Roervik		A		A	A	A	A	B	A	A	B	A	A	A			A			A	A
SE5 Bredkaelen		A		A	A	A	A	B	A	A	B	A	A	A			A			A	A
SE8 Hoburg													A	A			A			A	A
SE11 Vavihill		A		A	A	A	A	B	A	A	B	A	A	A			A			A	A
SE12 Aspvreten		A		A	A	A	A	B	A	A	B	A	A	A			A			A	A
SI8 Iskrba													A				A			A	A
SK2 Chopok		A		A	B	A	A	C	A	B	D	A	B	B	D		B	D		B	
SK4 Stara Lesna		A		A	B	A	A	C	A	B	D	A	B	B	D		B	D		B	
SK5 Liesek		A		A	B	A	A	C	A	B	D	A	B	B	D		B	D		B	
SK6 Starina		A		A	B	A	A	C	A	B	D	A	B	B	D		B	D		B	
TR1 Cubuk11		A		A	A	A	A	D	A	D	A	A	C	B			B			A	A
YU5 Kamenicki vis		B		A	B	C	A	B	D	B	A	A	D	B							
YU8 Zabljak		B		A	B	C	A	B	D	B	A	A	D	B							

6.2 Ozone measurements

This year information on ozone data quality has also been included. The data quality is mainly dependent on calibration and maintenance procedures. There has been little information about this in the past, and a questionnaire has therefore been distributed with questions about calibration and maintenance frequency, as well as information about local vegetation and possible local sources of NO_x. The answers are found in Annex 4 while a summary of the information is given in Table 8. Generally the calibration routines are satisfactory at all the stations.

Table 8: Summary of the calibration and maintenance routines at the different stations. Overview of surroundings and calibration routines for all EMEP's ozone stations.

Station Code and Name	Vegetation[1]	local sources[2)] of NO_x	Height of inlet (m)	Length of sample line (m)	Maintenance interval[3)]	Calibration interval[3)]	Transfer standard interval[3)]	NIST location and frequency[3)]
AT02 Illmitz	g; wy; w	little	3.2	0.5-0.8	2w	d	4m	EMPA, y
AT04 St. Koloman	me; f	little	3.2	0.5-0.8	2w	d	4m	EMPA, y
AT05 Vorhegg	me: f	little	3.2	0.5-0.8	2w	d	4m	EMPA, y
CH02 Payerne	g; ar	little	4	6	2w/y	d	3m	EMPA, 4m
CH03 Tänikon	ar	little tr	4	6	2w/3m	d	3m	EMPA, 4m
CH04 Chaumont	g	n	4	6	2w/y	d	3m	EMPA, 4m
CH05 Rigi	g	n	4	6	2w/3m	d	3m	EMPA, 4m
CZ01 Svratouch	g	n	3.5	1.7	2w	6m	y	CHMI , y
CZ03 Kosetice	g	n	3.5	1.7	2w	6m	y	CHMI, y
DE all stations							6m	EMPA, y
DK05 Keldsnor	t	n	3.6	3	w	d		ITM, y
DK31 Ulborg	f	n	18	23	w	d		ITM, y
DK32 Fredriksborg	f	n	18	23	w	d		ITM, y
EE09 Lahemaa	g	n	4	5	m/y	m	no transfer standard, help from FMI yearly	
EE11 Vilsandy	g	n	4	5	m/y	m		
ES01 San Pablo	m; f	little	3.5	3.7	15d	15d	6m	CarlosIII, 6m
ES03 Roquetas	f; ba	tr	3.5	3.7	15d	15d	6m	CarlosIII, 6m
ES04 Logrono	fa; f	much tr	3.5	3.7	15d	15d	6m	CarlosIII, 6m
ES05 Noia	bu; f	tr	3.5	3.7	15d	15d	6m	CarlosIII, 6m
ES07 Viznar	f; fa	little tr	3.5	3.7	15d	15d	6m	CarlosIII, 6m
ES08 Niembro	w; fa	little tr	3.5	3.7	15d	15d	6m	CarlosIII, 6m
ES09 Campisábalos	cf	n	3.5	3.7	15d	15d	6m	CarlosIII, 6m
ES10 Cabo de Creus	w; f	tr	3.5	3.7	15d	15d	6m	CarlosIII, 6m
ES11 Barcarrota	f; w	n	3.5	3.7	15d	15d	6m	CarlosIII, 6m
ES12 Zarra	f; u.s	n	3.5	3.7	15d	15d	6m	CarlosIII, 6m
FI09 Utö	treeless	some boat tr	5	4	3m	3m	3m	FMI, y
FI17 Virolahti	f; g		5	4	3m	3m	3m	FMI, y
FI22 Oulanka	f; bh		5	4	3m	3m	3m	FMI, y
FI37 Ähtäri	cf; bh; w		5	4	3m	3m	3m	FMI, y
FR08 Donon	f	n	7,16,30,44	60	15d/m	15d	3m	LNE, 3m
FR09 Revin	f	n	2.5	3	w/15d	w	2m	LNE, 3m
FR10 Morvan	f	n	3	5	m	w	6m	LNE, 3m
FR13 Peyrusse Vieille	g	n	4	6	15d/6m	15d	6m	LNE, 3m
FR14 Montandon	f; gr	n	2.5	5	15d/m	3d	3m	LNE, 3m

Table 8, cont.

Station Code and Name	Vegetation[1]	local sources[2)] of NO_x	Height of inlet (m)	Length of sample line (m)	Maintenance interval[3)]	Calibration interval[3)]	Transfer standard interval[3)]	NIST location and frequency[3)]
GB02 Eskdalemuir	g		3	4	3m/6m	3m	3m	NPL, 3 m
GB06 Lough Navar	f		2,5	4	3m/6m	3m	3m	NPL, 3 m
GB13 Yarner Wood	h		5	4	3m6m	3m	3m	NPL, 3 m
GB14 High Muffles	f		3	4	3m/6m	3m	3m	NPL, 3 m
GB15 Strath Vaich	m		3	4	3m/6m	3m	3m	NPL, 3 m
GB31 Aston Hill	fi		3	4	3m/6m	3m	3m	NPL, 3 m
GB32 Bottesford	fa		5	4	3m/6m	3m	3m	NPL, 3 m
GB33 Bush	g; t		8	4	3m/6m	3m	3m	NPL, 3 m
GB34 Glazerbury	g		3	4	3m/6m	3m	3m	NPL, 3 m
GB35 Great Dun Fell	fa; t		2	40	3m/6m	3m	3m	NPL, 3 m
GB36 Harwell	fi		3	4	3m/6m	3m	3m	NPL, 3 m
GB38 Lullington Heath	h		3	4	3m/6m	3m	3m	NPL, 3 m
GB39 Sibton	fi;f		3	4	3m/6m	3m	3m	NPL, 3 m
GB43 Narberth	fi	some	3	4	3m/6m	3m	3m	NPL, 3 m
GB44 Somerton	fi		3	4	3m/6m	3m	3m	NPL, 3 m
GB45 Wicken Fen	fi; t		2,5	4	3m/6m	3m	3m	NPL, 3 m
GR01 Aliartos								
HU02 K-puszta	f	n	10	12	w	6m	6m	CHMI, y
IE031 Mace Head								
IT01 Montelibretti	g	some tr	2	1.5	15d[4)]	15d	3m	IAP, 3m
IT04 Ispra								
LT15 Preila								
LV10 Rucava	fa; t	n	3	8	y/4m	d	no	ITM, y
NL09 Kollumerwaard								
NL10 Vreedepeel								
NO01 Birkenes	f, w	n	2	3	3m	w	y	ITM, y
NO15 Tustervatn	f; w	n	2	3	3m	w	y	ITM, y
NO39 Kaarvatn	f; gr	n	2	3	3m	w	y	ITM, y
NO41 Osen	f; w	n	2	3	3m	w	y	ITM, y
NO42 Zeppelinfjellet	h; w	n	2	3	3m	w	y	ITM, y
NO43 Prestebakke	f	n	2	3	3m	w	y	ITM, y
NO45 Jeløya	f, g	some boat tr	2	3	3m	w	y	ITM, y
NO48 Voss	f	n	2	3	3m	w	y	ITM, y
NO52 Sandve	f; fa	n	2	3	3m	w	y	ITM, y
NO55 Karasjok	f; h	n	2	3	3m	w	y	ITM, y
NO56 Hurdal	f	tr	2	3	3m	w	y	ITM, y
PL02 Jarczew							3-4m	y
PL03 Sniezka							3-4m	y
PL04 Leba							6m	y
PL05 Diabla Gora	me; f	little	4.1	5	3m	w[5)]	3m	CHMI, y
PT04 Monte Velho								
RU01 Janiskoski								
RU13 Pinega								
RU16 Shepeljovo								
SE02 Rörvik	g	n	5	6	4m	4m	4m	ITM, y
SE11 Vavihill	g	n	5	7	4m	4m	4m	ITM, y
SE12 Aspvreten	f	n	5	6	4m	4m	4m	ITM, y
SE13 Esrange	hillside; t	n	4	5	4m	4m	4m	ITM, y
SE32 Norra Kvill	g; f	n	5	7	4m	4m	4m	ITM, y
SE35 Vindeln	f	n	3	4	4m	4m	4m	ITM, y

Table 8, cont.

Station Code and Name	Vegetation[1]	local sources[2)] of NO_x	Height of inlet (m)	Length of sample line (m)	Maintenance interval[3)]	Calibration interval[3)]	Transfer standard interval[3)]	NIST location and frequency[3,6)]
SI08 Iskrba	c.f; g	little tr	5.5	5	m/6m	d	6m	CHMI y
SI31 Zavodnje	f,g p	some	2.5	1.5	6m/y	d	y	CHMI y
SI32 Krvavec	g; c.f	some, pp	10	8	4m	d	4m	CHMI y
SI33 Kovk	f; g; p	some, pp	2.5	1.5	m/y	d	y	CHMI y
SK02 Chopok	g	n	3.5-4	2-2.5	m/y	d	6m	CHMI y
SK04 Stara Lesna	c.f; g	little tr	3.5-4	2-2.5	m/y	d	6m	CHMI y
SK06 Starina	f	n	3.5-4	2-2.5	m/y	d	6m	CHMI y

1) ar: arable; g: grass; ba: built up area; bh: bog and heather; bu: bush; cf: coniferous forest; fa: farmland; f: forest; fi: field; gr: graze; m: moor; me: meadow; p: pasture; t: some trees; w: water; wy: wine yard; us: unproductive soil;
2) n: negligible; tr: traffic; pp: power plant
3) d: daily. w: weekly; m; monthly; y: yearly
4) Some maintenance not performed on routine basis
5) span checks not performed
6) EMPA: Swiss Federal Laboratories for Materials Testing and Research; ITM: Institute of Applied Environmental Research, Stockholm University; CarlosIII: Instituto de Salud CarlosIII, Madrid , FMI: Finnish Meteorological Institute; NLE: Laboratoire National d'Essais, Paris; NPL: National Physical Laboratory, UK; CHMI: Czech Hydrometeorological Institute, IAP: Institute of Atmospheric Polllution, Rome.

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Annex 1

Data quality objectives

10 % accuracy or better for oxidised sulphur and oxidised nitrogen in single analysis in the laboratory,

15 % accuracy or better for other components in the laboratory,

0.1 units for pH,

15–25% uncertainty for the combined sampling and chemical analysis (components to be specified later),

90 % data completeness of the daily values.

The targets, with respect to accuracy in the laboratory, for the very lowest concentrations of the main components in precipitation follow the WMO GAW (1992) recommendations for regional stations:

	Accuracy	
SO_4^{2-}	0.032 mg S/l	(1 µmol/l)
NO_3^-	0.014 mg N/l	(1 µmol/l)
NH_4^+	0.028 mg N/l	(2 µmol/l)
Cl^-	0.107 mg Cl/l	(3 µmol/l)
Ca^{2+}	0.012 mg Ca/l	(0.3 µmol/l)
K^+	0.012 mg K/l	(0.3 µmol/l)
Mg^{2+}	0.007 mg Mg/l	(0.3 µmol/l)
Na^+	0.007 mg Na/l	(0.3 µmol/l)

The targets for the wet analysis of components extracted from air filters are the same as for precipitation. For SO_2 the limit above for sulphate is valid for the medium volume method with impregnated filter. For NO_2 determined as NO_2^- in solution the accuracy for the lowest concentrations is 0.01 mg N/l.

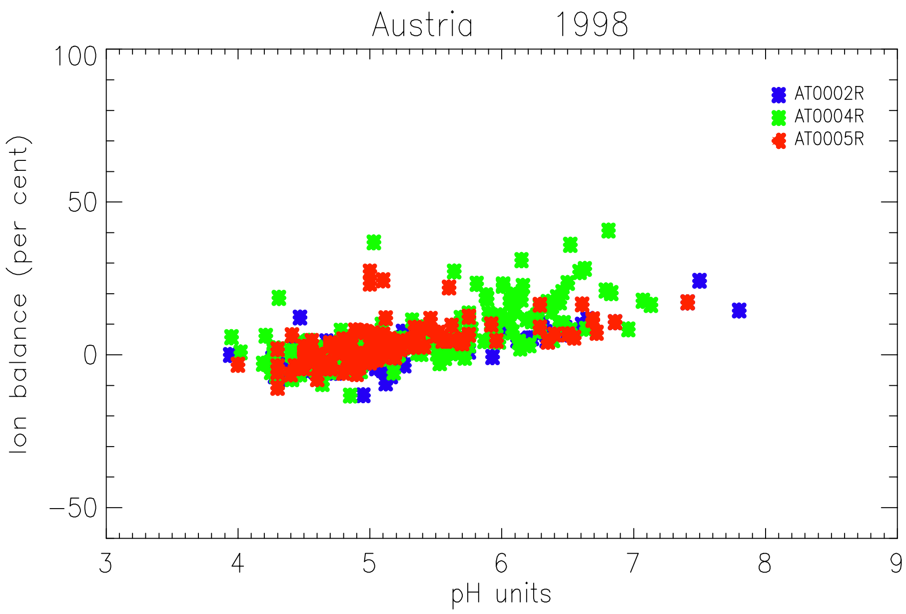
The aim for data completeness is valid for the current definition used by the CCC. This definition will, however, be harmonised with the WMO GAW definition and modified.

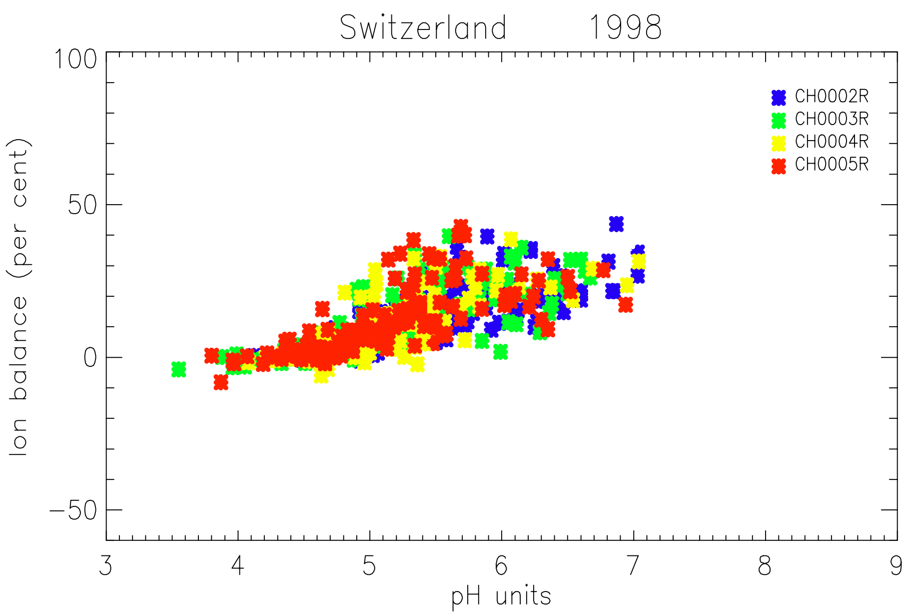
It is understood that there is a need to investigate additional uncertainty caused by local influence on the measurements at the sites (not representative siting).

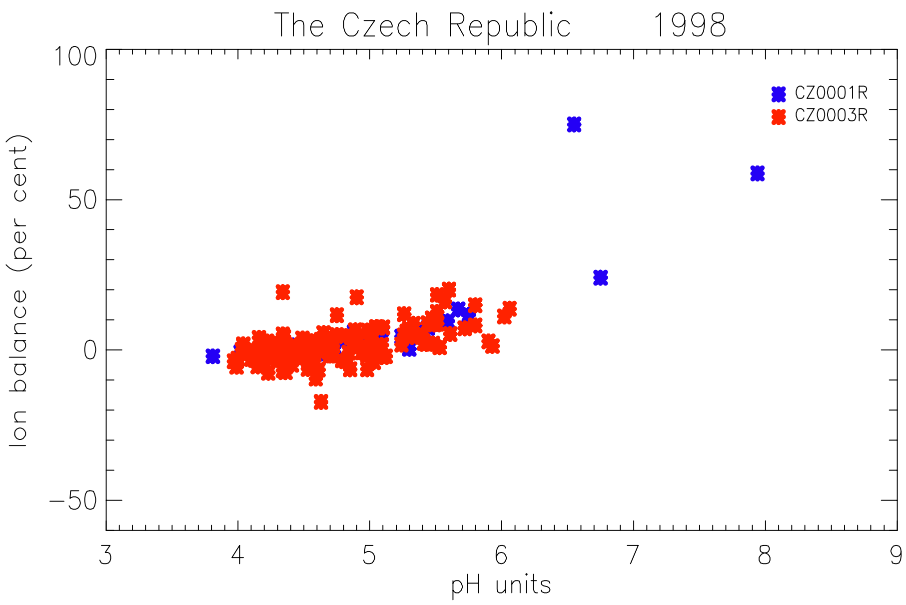
It may be necessary to reconsider the DQO for volatile organic components (VOC), persistent organic pollutants (POP), and trace metals (HM).

Annex 2

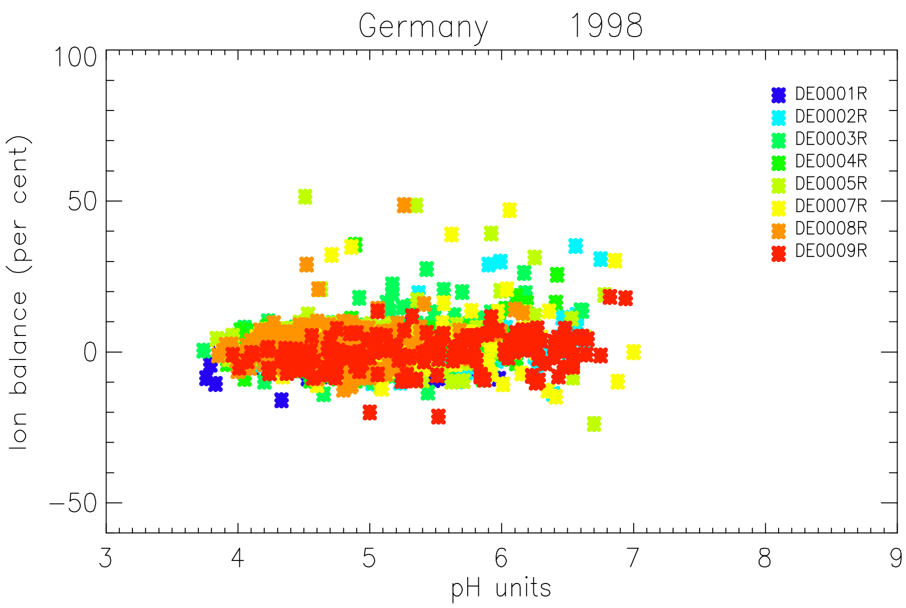
Ion balances in precipitation samples 1998


Austria 1998
100
50
0
−50
Ion balance (per cent)
3
4
5
6
7
8
9
pH units
AT0002R
AT0004R
AT0005R

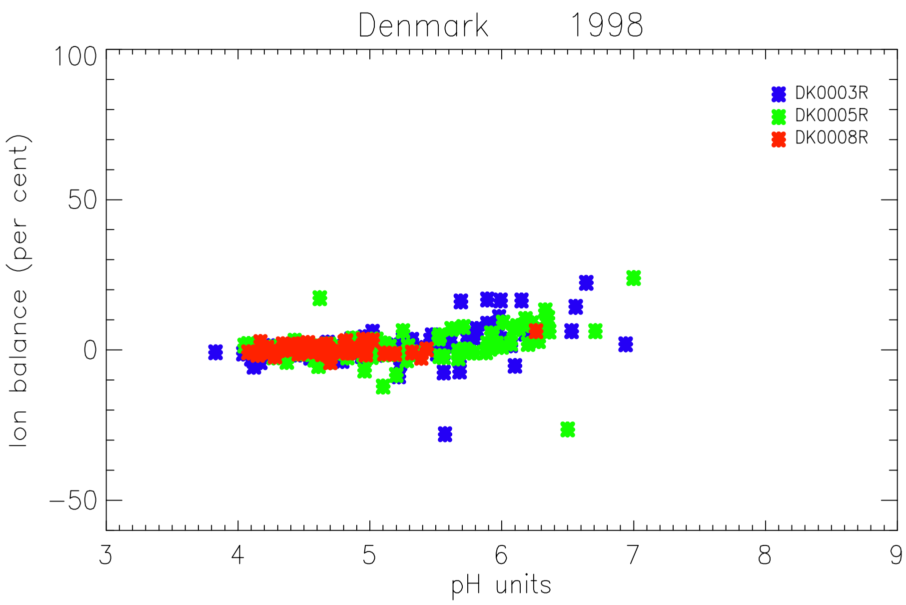

Switzerland 1998
100
50
0
−50
Ion balance (per cent)
3
4
5
6
7
8
9
pH units
CH0002R
CH0003R
CH0004R
CH0005R

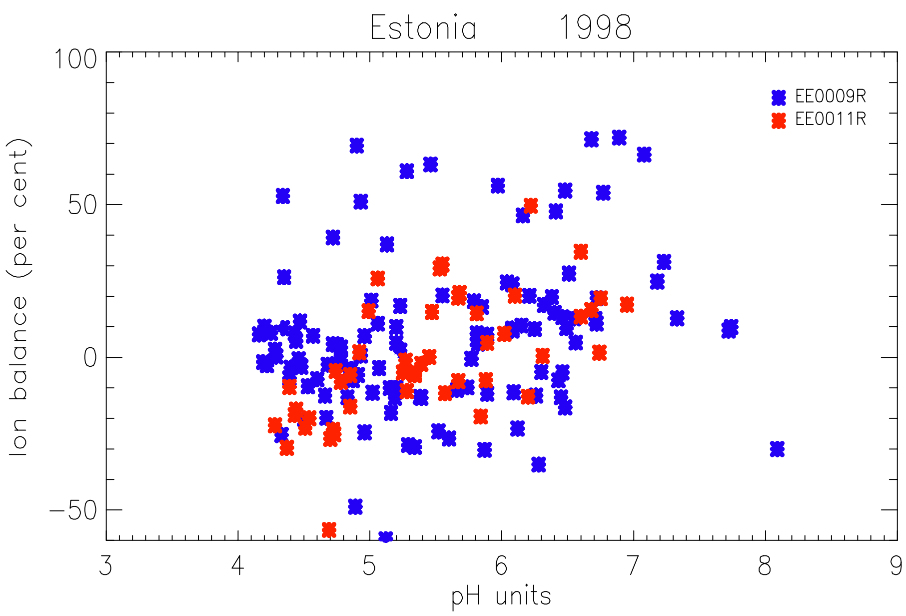


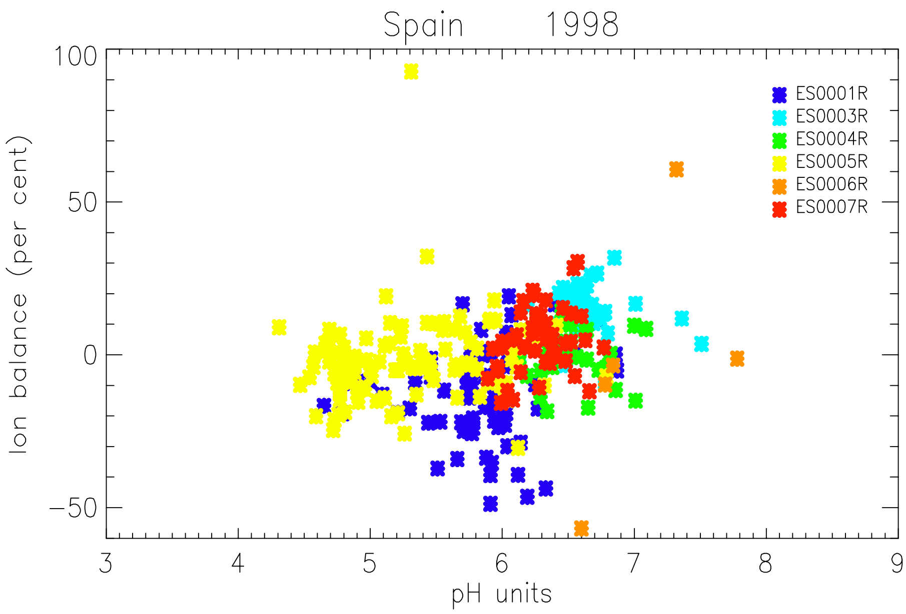
The Czech Republic 1998
Ion balance (per cent)
pH units
CZ0001R
CZ0003R
100
50
0
−50
3
4
5
6
7
8
9

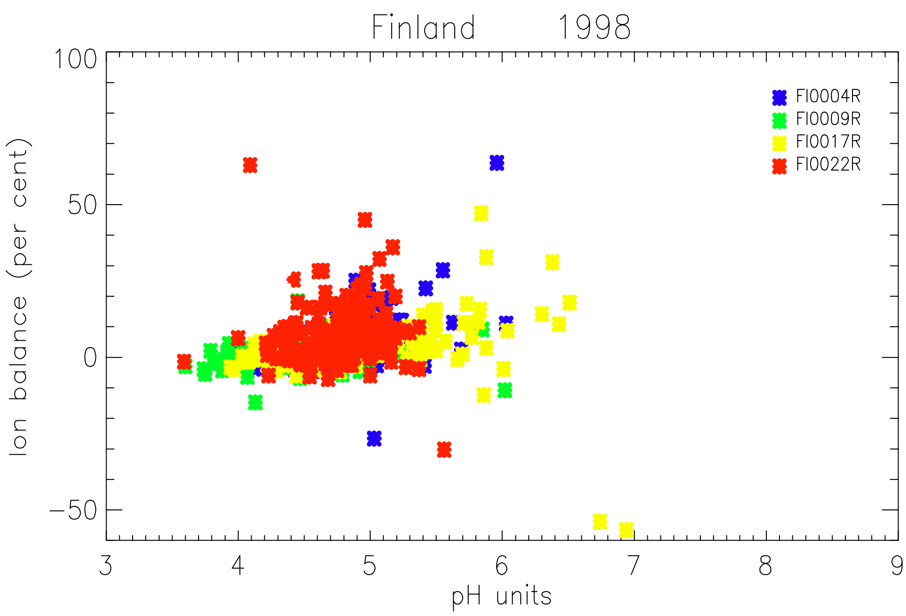


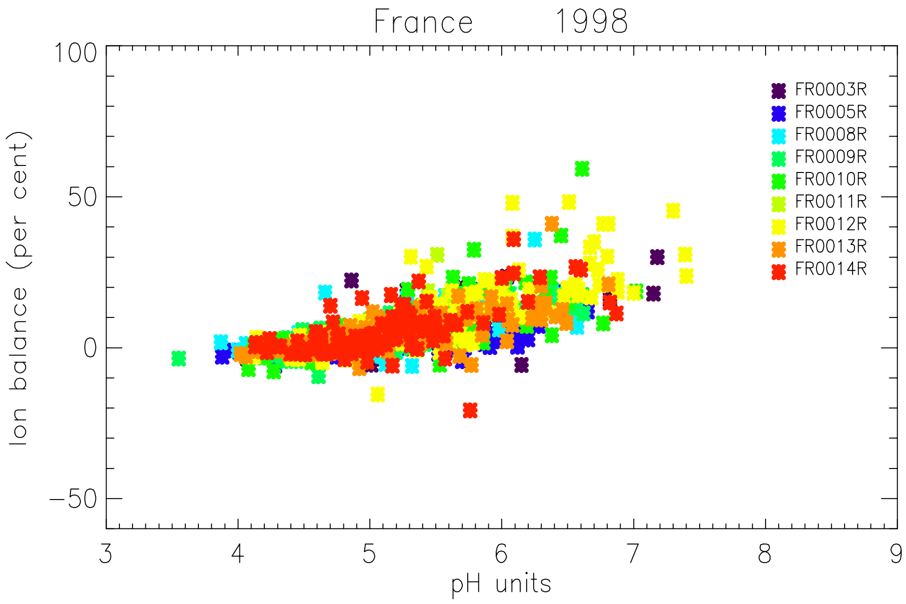
Germany 1998
Ion balance (per cent)
pH units
DE0001R
DE0002R
DE0003R
DE0004R
DE0005R
DE0007R
DE0008R
DE0009R
100
50
0
−50
3
4
5
6
7
8
9

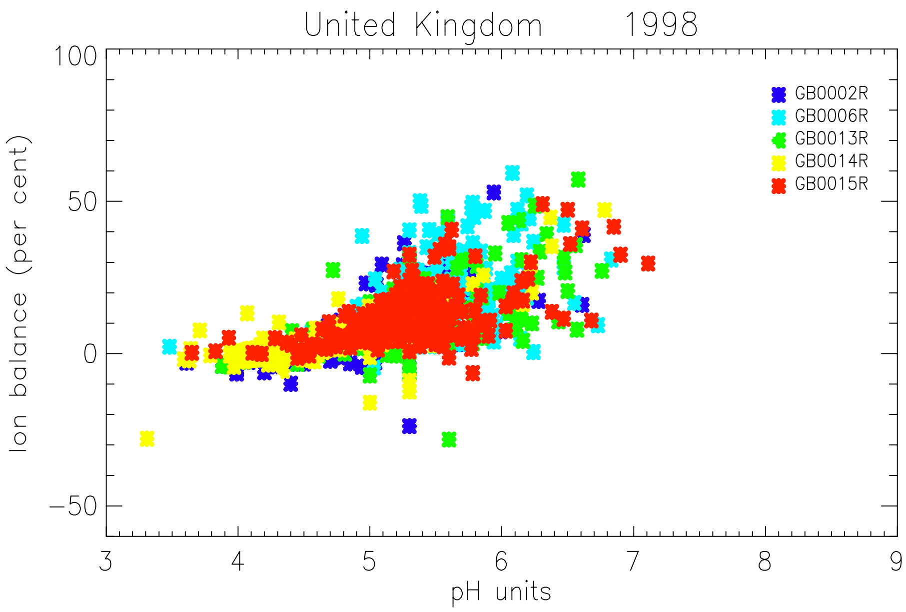

Denmark 1998
100
50
0
−50
Ion balance (per cent)
3
4
5
6
7
8
9
pH units
DK0003R
DK0005R
DK0008R

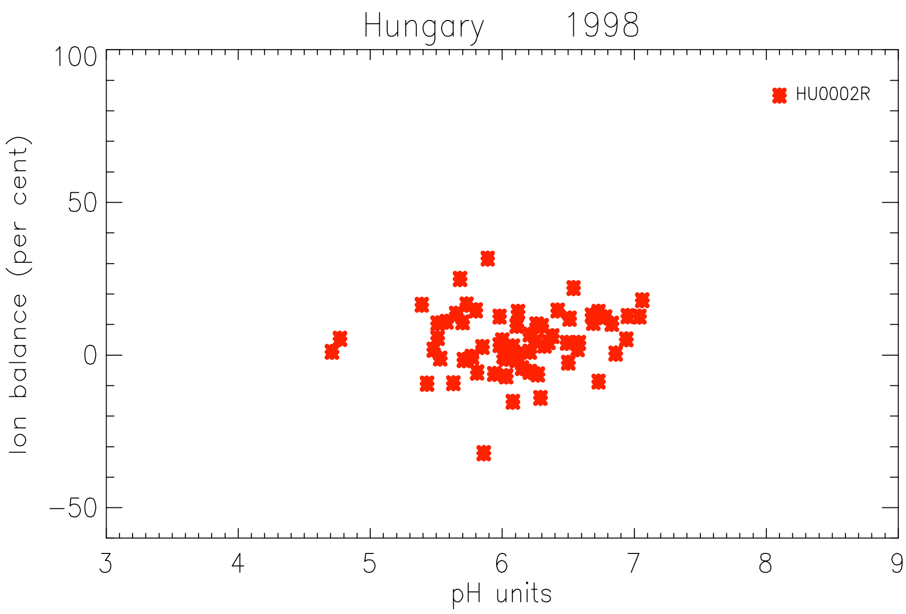

Estonia 1998
100
50
0
−50
Ion balance (per cent)
3
4
5
6
7
8
9
pH units
EE0009R
EE0011R

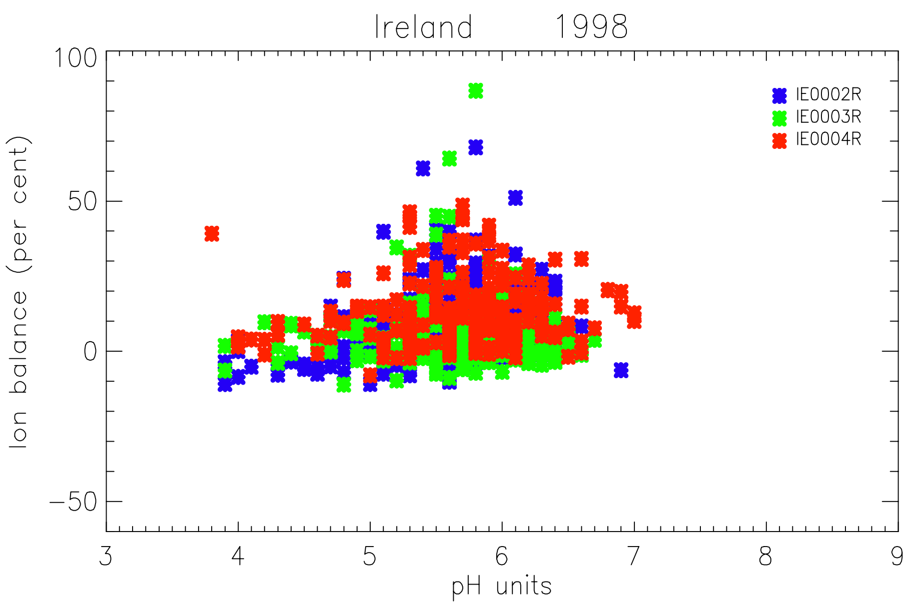

Spain 1998
100
50
0
−50
Ion balance (per cent)
3
4
5
6
7
8
9
pH units
ES0001R
ES0003R
ES0004R
ES0005R
ES0006R
ES0007R

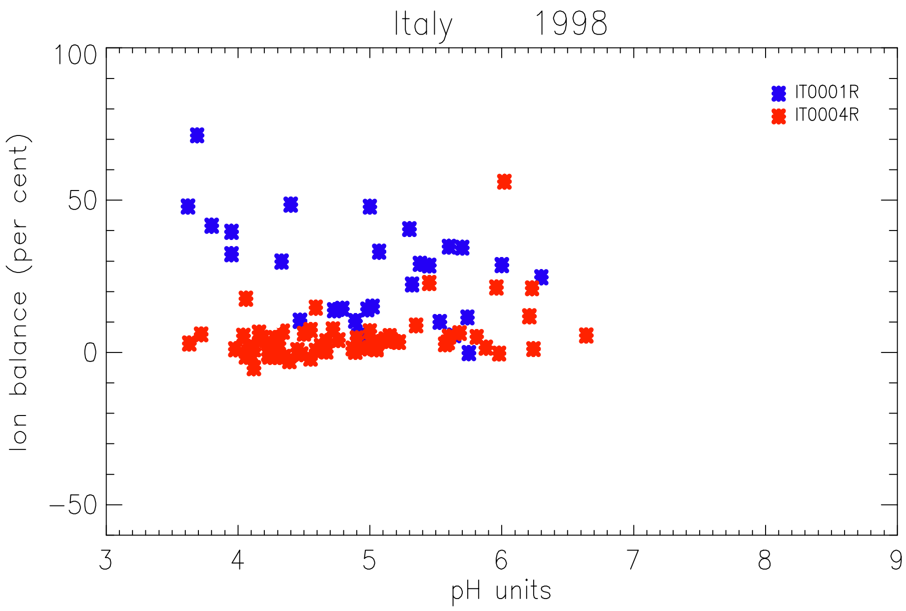

Finland 1998
100
50
0
−50
Ion balance (per cent)
3
4
5
6
7
8
9
pH units
FI0004R
FI0009R
FI0017R
FI0022R

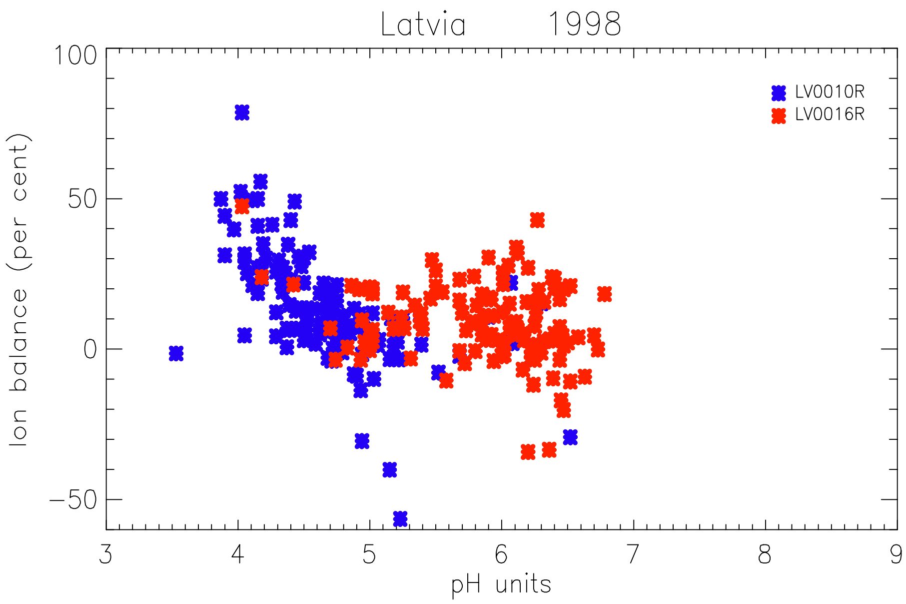

France 1998
100
50
0
−50
Ion balance (per cent)
3
4
5
6
7
8
9
pH units
FR0003R
FR0005R
FR0008R
FR0009R
FR0010R
FR0011R
FR0012R
FR0013R
FR0014R

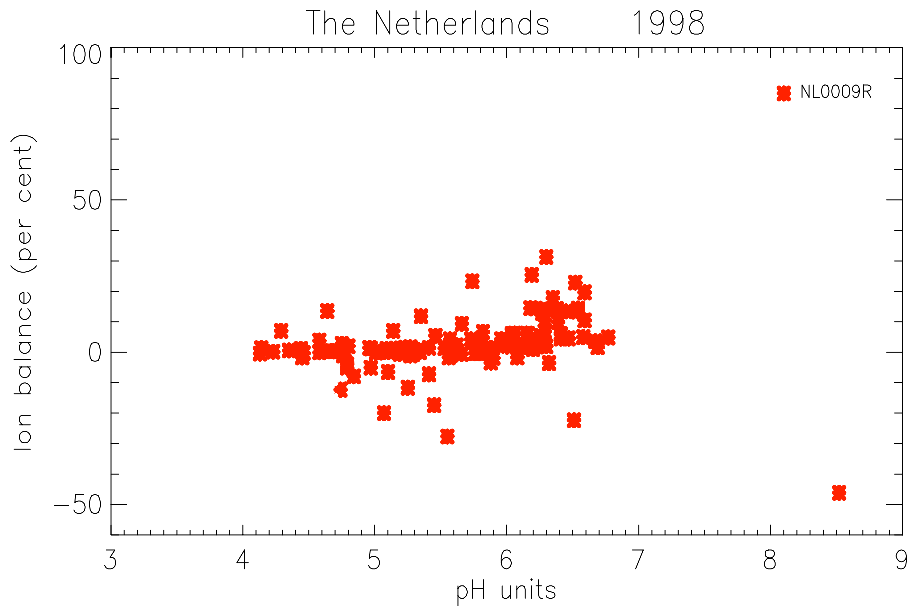

United Kingdom 1998
100
50
0
−50
Ion balance (per cent)
3
4
5
6
7
8
9
pH units
GB0002R
GB0006R
GB0013R
GB0014R
GB0015R

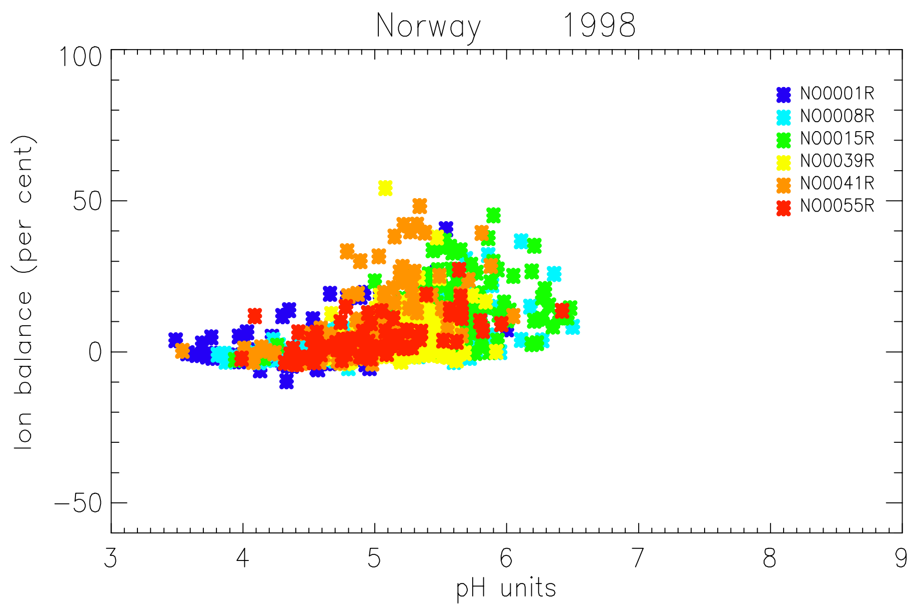

Hungary 1998
HU0002R
Ion balance (per cent)
pH units
100
50
0
−50
3
4
5
6
7
8
9

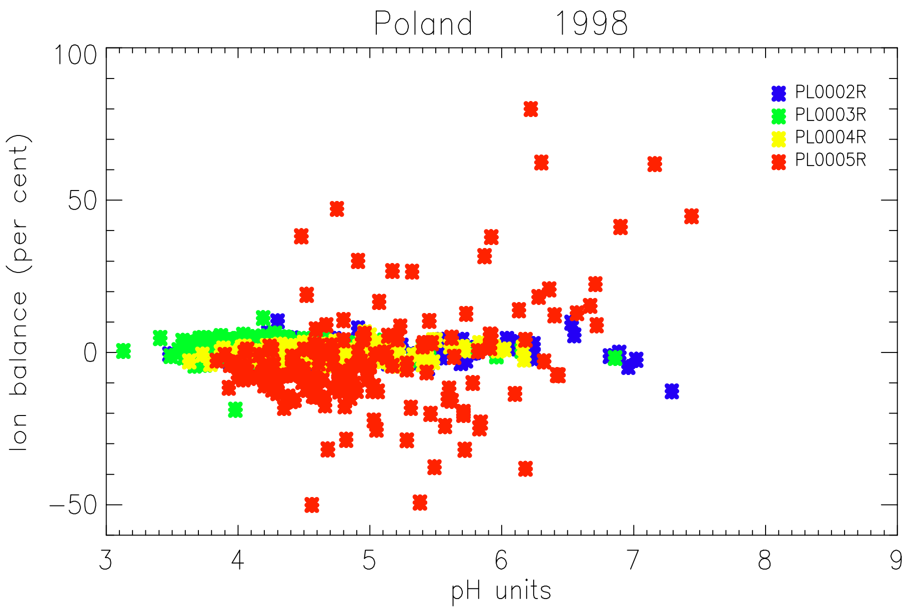

Ireland 1998
IE0002R
IE0003R
IE0004R
Ion balance (per cent)
pH units
100
50
0
−50
3
4
5
6
7
8
9

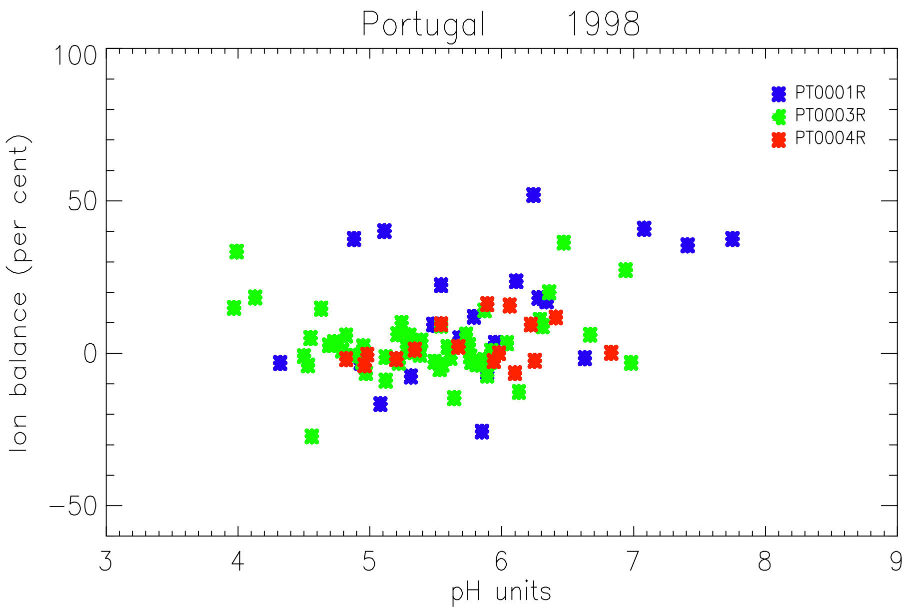

Italy 1998
100
50
0
−50
Ion balance (per cent)
3
4
5
6
7
8
9
pH units
IT0001R
IT0004R

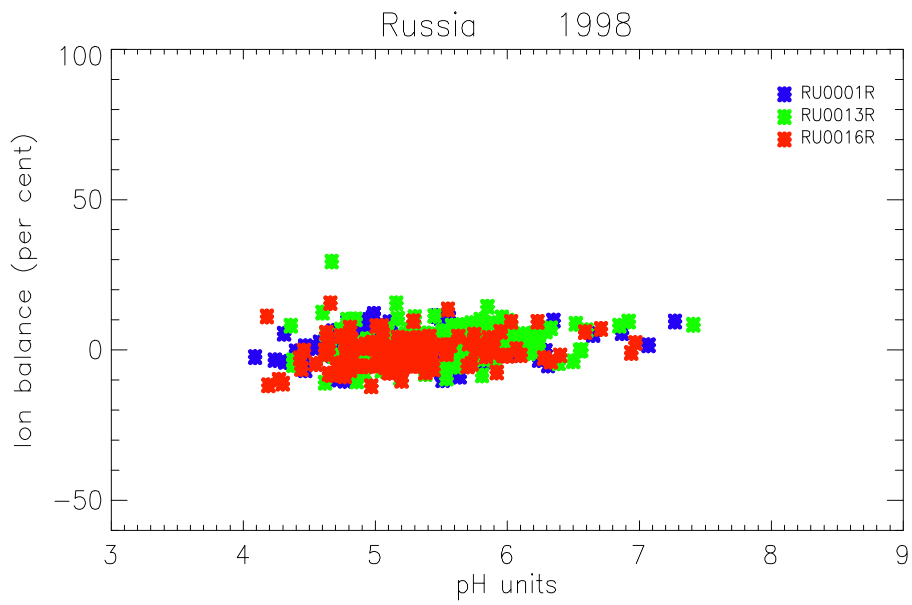

Latvia 1998
100
50
0
−50
Ion balance (per cent)
3
4
5
6
7
8
9
pH units
LV0010R
LV0016R

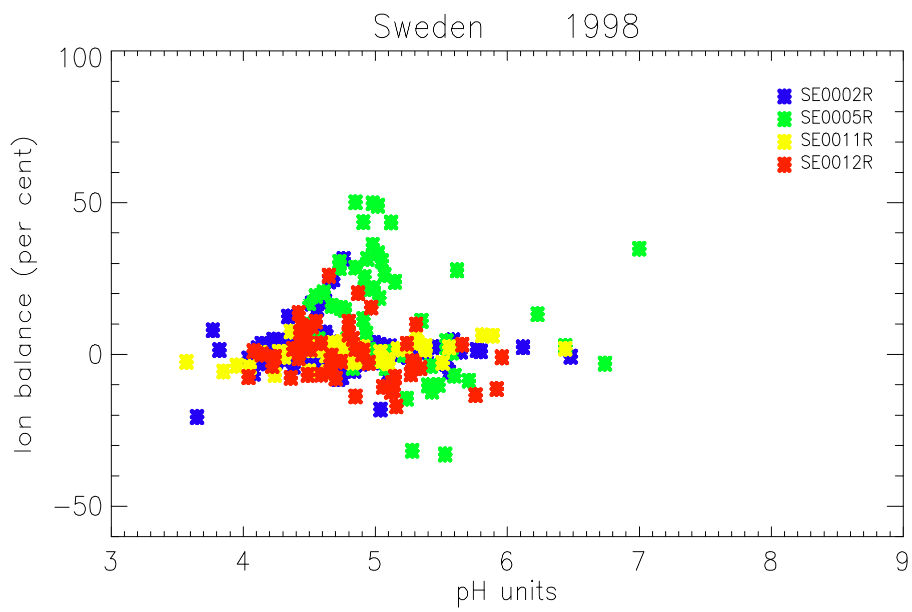

The Netherlands 1998
Ion balance (per cent)
pH units
NL0009R

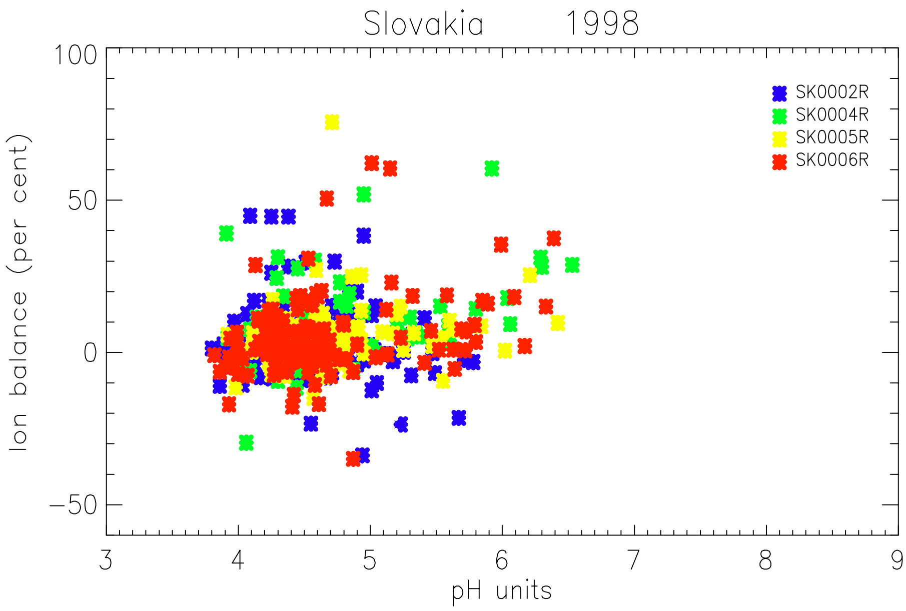

Norway 1998
Ion balance (per cent)
pH units
NO0001R
NO0008R
NO0015R
NO0039R
NO0041R
NO0055R

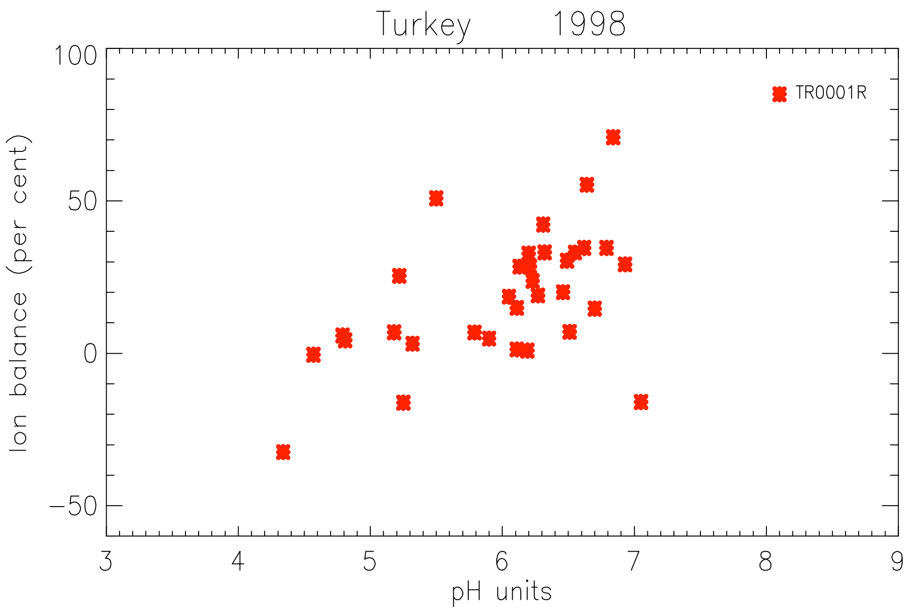

Poland 1998
PL0002R
PL0003R
PL0004R
PL0005R
Ion balance (per cent)
pH units
100
50
0
−50
3
4
5
6
7
8
9

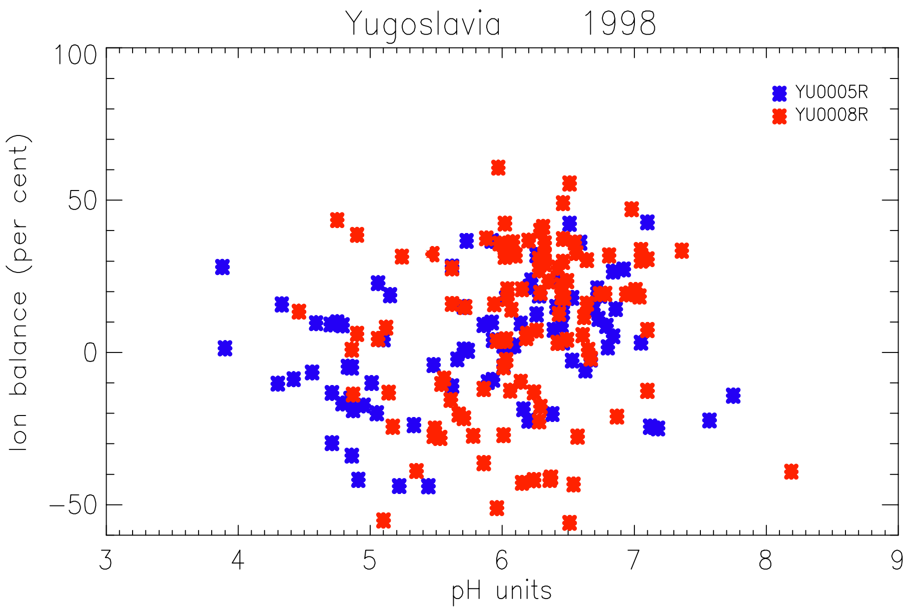

Portugal 1998
PT0001R
PT0003R
PT0004R
Ion balance (per cent)
pH units
100
50
0
−50
3
4
5
6
7
8
9


Russia 1998
100
50
0
−50
Ion balance (per cent)
3
4
5
6
7
8
9
pH units
RU0001R
RU0013R
RU0016R


Sweden 1998
100
50
0
−50
Ion balance (per cent)
3
4
5
6
7
8
9
pH units
SE0002R
SE0005R
SE0011R
SE0012R


Slovakia 1998
Ion balance (per cent)
pH units
SK0002R
SK0004R
SK0005R
SK0006R
100
50
0
−50
3
4
5
6
7
8
9


Turkey 1998
Ion balance (per cent)
pH units
TR0001R
100
50
0
−50
3
4
5
6
7
8
9


Yugoslavia 1998
YU0005R
YU0008R
Ion balance (per cent)
pH units
100
50
0
−50
3
4
5
6
7
8
9

Annex 3

Detection limits and precision

Table 3.1:

Ozone		
Country / site	Laboratory	Measurement precision
Commission of European Community	Joint Research Centre, Ispra Establishment	4 µg/m3 (from 1996)
Denmark	National Environmental Research Institute, Roskilde	2 ppb + 8% of the measured value (1997)
Estonia	Estonian Environmental Research Centre, Tallinn	2 µg/m3
Finland	Finnish Meteorological Institute, Helsingfors	2 µg/m3
France	l'Ecole des Mines de Douai, Laboratoire Wolff, Douai	2 µg/m3 CoV= 0.01ppb
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome	2 µg /m3
Norway	Norwegian Institute for Air Research, Kjeller	2 µg /m3
Poland	Institute of Meteorology and Water Management, Warsaw	03< 200 µg/m3: 2 µg /m3 03> 200 µg/m3: 2%
Slovakia	Slovak Hydrometeorological Institute Bratislava	2 µg /m3
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	4 µg/m3 and 2 µg/m3 (1997)
Switzerland	Swiss Fed. Lab. for Materials testing and Research	c<30 µg/m3: 6 µg/m3 30 µg/m3 < c < 90 µg/m3: 6-9 µg/m3 c > 90 µg/m3: 10%
United Kingdom	AEA Technology, Culham Abington	2 ppb

Table 3.2:

Nitrogen dioxide			
Country / site	Laboratory	Laboratory precision	Method precision
Commission of European Communities	Joint Research Centre, Ispra Establishment		0.3 µg N/m3 (from 1996)
Czech Republic	Czech Hydrometeorological Institute, Prague	3.4 % RSD	12.2 % RSD
Denmark	National Environmental Research Institute, Roskilde	M.MAD: 0.01 mg N/l CoV: 2.1 %	
Estonia	Estonian Environmental Research Centre, Tallinn		2 µg/m3
Finland	Finnish Meteorological Institute, Helsingfors		0.3 µg N/m3
Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	ca. 5% RSD	
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome		0.6 µg N/m3
Latvia	Latvian Hydrometerological Agency, Riga	2%	
Lithuania	Institute of Physics, Vilnius	c=0.02-0.06 mg N/l; 3-8.2% RSD	c<1.0µg N/m3; 8.2 % RSD c> 1.0 µg N/m3; 3.8 % RSD
Norway	Norwegian Institute for Air Research, Kjeller	c=0.034 µg N/ml: 7% RSD c=0.17µg N/ml:4.6% RSD c=0.08 µg N/ml:4.2% RSD	
Poland	Institute of Meteorology and Water Management, Warsaw	c= 0.30 mg N/l; 1.0%RSD c= 0.03 mg N/l; 5.9% RSD	
Spain	Instituto de Salud Carlos III	1.5%	
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	2%	CoV: 5%
Switzerland	Swiss Fed. Lab. for Materials testing and Research		Daily mean c<30 µg N/m3: 1.2 µg N/m3; Annual mean c<40 µg N/m3: 0.9 N/m3
Turkey	Refik Saydam Centre of Hygiene, Ankara	M.MAD: 0.04 mg N/l CoV: 12.6 %	

Table 3.3:

Sulphur dioxide			
Country / site	Laboratory	Laboratory precision	Method precision
Commission of European Communities	Joint Research Centre, Ispra Establishment		1.3 µg S/m3 (from 1996)
Czech Republic	Czech Hydrometeorological Institute, Prague	1.5 % RSD	M.MAD: 0.746 µg S/m3; CoV: 18.9%
Denmark	National Environmental Research Institute, Roskilde	M.MAD: 0.03 µg S/m3 CoV: 1.9%	M.MAD: 0.02 µg S/m3; CoV: 5%
Estonia	Estonian Environmental Research Centre, Tallinn		1% of reading or 3 µg/m3
Finland	Finnish Meteorological Institute, Helsingfors	c=0.65 mgS/l 7.1%RSD c=1.6 mgS/l: 2.6% RSD	
France	l'Ecole des Mines de Douai, Laboratoire Wolff, Douai	c= 0.01-0.1 mg S/l: 8-12% RSD c= 0.1-0.5 mg S/l: 1-3% RSD	
Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	<10% RSD	0.28 µg S/m3
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome		c= 2 µg S/m3; 7.2% RSD
Lithuania	Institute of Physics, Vilnius	c< 0.5 mg S/l; 1.3-3.8% RSD c>1.5 mg S/l; 1.0 % RSD	c<1.5 mg S/m3; 1.3-3.8% RSD c>1.5 mg S/m3; 1.0 % RSD
Norway	Norwegian Institute for Air Research, Kjeller		c< 4.2 µg S/m3: M.MAD 0.012 µg S/m3
Russian Federation	Institute of Global Climate and Ecology, Moscow		RU16: M.MAD = 0.01 CoV = 1.8%
Slovakia	Slovak Hydrometeorological Institute, Bratislava	c=1 mg S/l: 0.75% RSD	
Slovenia	Hydrometeorological Institute of Slovenia, Ljubljana		0.045 mg S/l
Spain	Instituto de Salud Carlos III	4.3%	
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	2%	CoV = 5%
Switzerland	Swiss Fed. Lab. for Materials testing and Research		c<0.4 µg S/m3: M.MAD=0.04 µg S/m3 c>0.4 µg S/m3 M.MAD=10% monitors: c<30 µg S/m3: M.MAD=1.5 µg S/m3 (daily mean) c>30 µg S/m3 M.MAD=10% (daily mean)
Turkey	Refik Saydam Centre of Hygiene, Ankara	M.MAD:0.06 mg S/l CoV: 19 %	
United Kingdom	AEA Technology, Culham Abington	2% RSD	

Table 3.4:

Sulphate in air			
Country / site	Laboratory	Laboratory precision	Method precision
Commission of European Communities	Joint Research Centre, Ispra Establishment	0.07 µg S/m3 (from 1996)	
Czech Republic	Czech Hydrometeorological Institute, Prague	<1.5 % RSD	M.MAD: 0.484 µg S/m3 CoV=13.5%
Denmark	National Environmental Research Institute, Roskilde		M.MAD=0.05 µg S/m3 CoV=6.5%
Finland	Finnish Meteorological Institute, Helsingfors	c=0.65 mg S/l: 4% RSD c=1.6 mg S/l; 2.6% RSD	
France	l'Ecole des Mines de Douai, Laboratoire Wolff, Douai	0.01<c<0.1 mgS/l 8-12% 0.1<c<0.5 mg S/l; 1-3%	
Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	<10% RSD	0.12 µg S/m3
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome		c= 1 µg S/m3; 1.4% RSD
Lithuania	Institute of Physics, Vilnius	c<0.5 mg S/l; 8% RSD c>0.5 mg S/l; 3.2% RSD	c<0.6 µg S/m3; 8% RSD c>0.6µg S/m3; 3.2% RSD
Norway	Norwegian Institute for Air Research, Kjeller		c= < 2.4 µg S/m3; M.MAD 0.009 µg S/m3
Russian Federation	Institute of Global Climate and Ecology, Moscow		RU1:M.MAD=0.01 µg S/m3 and CoV =3.2%. RU16: M.MAD=0.021 µg S/m3 and CoV =3.7% RU20: M.MAD=0.01 µg S/m3 and CoV =3%
Slovakia	Slovak Hydrometeorological Institute, Bratislava	c=0.17 mg S/l: 4.3% RSD	
Slovenia	Hydrometeorological Institute of Slovenia, Ljubljana		0.01 mgS/l
Spain	Instituto de Salud Carlos III	1.4%	
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	2%	CoV=5%
Switzerland	Swiss Fed. Lab. for Materials testing and Research		0.25 µg S/m3
Turkey	Refik Saydam Centre of Hygiene, Ankara	M.MAD: 0.021 mg S/l CoV = 9.5%	
United Kingdom	AEA Technology, Culham Abington	2% RSD	

Table 3.5:

Nitrate + nitric acid in air			
Country / site	Laboratory	Laboratory precision	Method precision
Commission of European Communities	Joint Research Centre, Ispra Establishment	0.17 µg N/m3 (from 1996)	
Denmark	National Environmental Research Institute, Roskilde	NO3: M.MAD: 0.01 µg N/m3 CoV: 2.1% HNO3: M.MAD: 0.01 µg N/m3 CoV: 1.8%	M.MAD: 0.04 µg N/m3 CoV: 7.3%
Finland	Finnish Meteorological Institute, Helsingfors	NO3: c=0.35 mg N/l; 5.1% RSD, c=0.9 mg N/l; 3.0% RSD HNO3: c=0.35 mg N/l; 4.3% RSD c=0.9 mg N/l; 2.6% RSD	
Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	<10% RSD	0.05 µg N/m3
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome		NO3: c= 1.0 µg N/m3; 1.4% RSD HNO3: c= 0.25 µg N/m3; 6.5% RSD
Lithuania	Institute of Physics, Vilnius	c< 1 mg N/l: 3.2% RSD	c<1.25 µg N/m3; 3.2 % RSD
Norway	Norwegian Institute for Air Research, Kjeller		c<1.6 µg N/m3: M.MAD= 0.012 µg N/m3
Slovakia	Slovak Hydrometeorological Institute, Bratislava	NO3: c= 0.045 mg N/l; 3.03% HNO3: c=0.05 mg N/l; 3.0.%	
Slovenia	Hydrometeorological Institute of Slovenia, Ljubljana		NO3: 0.02 mg N/l HNO3: 0.16 mg N/l jan-jun HNO3: 0.02 mg N/l jul-dec
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	2%	NO3: CoV=3%
Switzerland	Swiss Fed. Lab. for Materials testing and Research		0.13 µg N/m3
Turkey	Refik Saydam Centre of Hygiene	HNO3: M.MAD = 0.006 mg N/l CoV 9.8% NO3: M.MAD = 0.004 mg N/l CoV 5.9%	

Table 3.6:

Ammonia + Ammonium in air			
Country / site	Laboratory	Laboratory precision	Method precision
Commission of European Communities	Joint Research Centre, Ispra Establishment	0.94 µg N/m3 (from 1996)	
Denmark	National Environmental Research Institute, Roskilde	NH3: M.MAD: 0.05 µg N/m3 CoV: 2.6% NH4: M.MAD: 0.05 µg N/m3 CoV: 2%	M.MAD: 0.134 µg N/m3 CoV: 6.6%
Finland	Finnish Meteorological Institute, Helsingfors	c=0.22 mg N/l; 7.3% RSD, c=0.72 mg N/l; 2.7% RSD c=1.42 mg N/l; 2.8% RSD	
Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	<10% RSD	NH3: 0.18 µg N/m3 NH4: 0.30 µg N/m3
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome		c= 1 µg N/m3; 4.5% RSD
Latvia	Latvian Hydrometerological Agency, Riga	NH4: 0.7% RSD	
Lithuania	Institute of Physics, Vilnius	c<1.2 mg N/l; 4.8% RSD	c<1.25 µg N/m3; 4.8% RSD
Norway	Norwegian Institute for Air Research, Kjeller		c <3.2 µg N/m3; M.MAD 0.039 µg N/m3
Russian Federation	Institute of Global Climate and Ecology, Moscow		RU1:M.MAD=0.01µg N/m3 and CoV =4.8%. RU16, NH4: M.MAD=0.01µg N/m3 and CoV =2.7% RU20. NH4: M.MAD=0.01µg S/m3 and CoV =2.3%
Slovenia	Hydrometeorological Institute of Slovenia, Ljubljana		NH4: 0.015 mg N/l NH3: 0.23 mg N/l jan-jun NH3: 0.03 mg N/l jul-dec
Spain	Instituto de Salud Carlos III	2.7%	
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	3%	CoV = 3%
Switzerland	Swiss Fed. Lab. for Materials testing and Research		0.45 µg N/m3
Turkey	Refik Saydam Centre of Hygiene	NH3: M.MAD: 0.005 mg N/l; CoV = 2.8% NH4: M.MAD = 0.005 mg N/l; CoV:1.9 %	

Table 3.7:

Nitrate in precipitation			
Country / site	Laboratory	Laboratory precision	Method precision
Austria	Umweltbundesamt, Klagenfurt	1 % RSD	
Commission of European Com.	Joint Research Centre, Ispra Establishment	0.02 mg N/l (from 1996)	
Czech Republic	Czech Hydrometeor. Institute, Prague	2.1 % RSD	M.MAD 0.109 mg/l; CoV 4.4%
Denmark	National Env. Research Institute, Roskilde	M.MAD: 0.01 mg N/l CoV: 1.1 %	
Estonia	Estonian Environmental Research Centre, Tallinn	2%	
Finland	Finnish Meteorological Institute, Helsingfors	c= 035 mg N/l; 3.1% RSD c= 0.9 mg N/l; 2.5 % RSD	

France	l'Ecole des Mines de
	Douai, Laboratoire Wolff,
	Douai
		c< 0.2 mg N/l; 5-10%
		c= 0.2-0.5 mg N/l;
		3-5%
		c= 0.5-5 mg N/l;
		1-3%	

Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	<10% RSD	
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome	c=0.5 mg Cl/l; 0.7 % RSD c=0.05 mg Cl/l; 1.6% RSD	c= 1mg N/l; 1.5% RSD
Latvia	Latvian Hydrometer. Agency, Riga	17% RSD	
Lithuania	Institute of Physics, Vilnius	c<0.5 mg N/l; 1% RSD c>0.5 mg N/l; 0.5% RSD	
Netherlands	National Ins. for Public Health and Env.Protection (RIVM), Bilthoven	$RSD=(2.2 + 0.0031/c^2)^{1/2}\%$; c=1.4 - 168 mg N/l: 1.5% RSD (from 1997)	
Norway	Norwegian Institute for Air Research, Kjeller	c=0.86 µg N/ml; 2.7% RSD c=0.39 µg N/ml; 4.1% RSD	
Poland	Institute of Meteorology and Water Management, Warsaw	c=4.52 mg N/l; 0.7% c=0.45 mg N/l; 1.7% c=0.23 mg N/l; 2.2%	
	Institute of Environmental Protection, Warsaw (PL5)	M.MAD: 0.02 mg N/l CoV: 4.4%	M.MAD: 0.016 mg N/l CoV.: 3.0%
Portugal	Ministèrio do ambiente e recursos naturais, Laboratorio de Santo Andre, Santo Andre	0.25%	

Table 3.7, cont.:

Nitrate in precipitation			
Country / site	Laboratory	Laboratory precision	Method precision
Russian Federation	Institute of Global Climate and Ecology, Moscow		RU1:M.MAD=0.005 µg N/m3 and CoV =5%. Ru13: M.MAD=0.01 µg S/m3 and CoV =5.8 %. RU16, M.MAD=0.01 µg N/m3 and CoV =2.9% RU20: M.MAD=0.01 µg N/m3 and CoV =3.9%
Slovakia	Slovak Hydrometeorological Institute, Bratislava	c=1.4 mg N/l; 0.2% c=0.05 mg N/l; 2.4%	
Slovenia	Hydrometeor. Institute of Slovenia, Ljubljana	7.5%	
Spain	Instituto de Salud Carlos III	1.2%	
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	2%	CoV = 4%
Switzerland	Swiss Fed. Lab. for Mat. testing and Research		M.MAD: 0.05 mg N/l
Turkey	Refik Saydam Centre of Hygiene	M.MAD: 0.03 mg N/l CoV: 9.4 %	
United Kingdom	AEA Technology, Culham Abington	4%	

Table 3.8:

Sulphate in precipitation			
Country / site	Laboratory	Laboratory precision	Measurement precision
Austria	Umweltbundesamt, Klagenfurt	2.4 % RSD	
Commission of European Communities	Joint Research Centre, Ispra Establishment	0.17 mg S/l (from 1996)	
Czech Republic	Czech Hydrometeorological Institute, Prague	0.9% RSD	M.MAD 0.107 mg S/l; CoV=4.1%
Denmark	National Env.l Research Institute, Roskilde	M.MAD: 0.01 mg S/l CoV: 1.13%	
Estonia	Estonian Environmental Research Centre, Tallinn	1%	
Finland	Finnish Meteorological Institute, Helsingfors	c=0.65 mg S/l; 2.4% RSD c=1.6 mg S/l; 2.1 % RSD	
France	l'Ecole des Mines de Douai, Laboratoire Wolff, Douai	c<0.2 mg S/l; 5 - 10% c= 0.2 - 0.5 mg S/l; 3 - 5% c= 0.5 - 5 mg S/l; 1 - 3%	
Greece	Ministry of Env., Physical Planning and Public Works	M.MAD: 0.10 mg S/l CoV: 7.8%	
Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	<10% RSD	
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome	c=0.5 mg S/l; 0.6% RSD c=0.05 mg S/l; 1.2 % RSD	c= 1mg S/l; 1% RSD
Latvia	Latvian Hydrometerological Agency, Riga	15% RSD	
Lithuania	Institute of Physics, Vilnius	c<0.5 mg S/l; 2-5% RSD c>0.5 mg S/l; 1 % RSD	
Netherlands	National Ins. for Public Health and Env.l Protection (RIVM), Bilthoven	RSD=(2.3+0.0018/c2)1/2%; c: 1.6-16 mg S/l: 1.5% RSD (from 1997)	
Norway	Norwegian Institute for Air Research, Kjeller	c= 2.23 µg S/ml: 1.8% RSD c= 0.85 µg S/ml: 2.2% RSD	
Poland	Institute of Meteorology and Water Management, Warsaw	c=6.68 mg S/l; 0.6% c=0.67 mg S/l; 1.5% c=0.33 mg S/l; 1.8%	
	Institute of Environmental Protection, Warsaw (PL5)	M.MAD:0.03 mg S/l CoV: 7.5%	M.MAD: 0.031 mg S/l CoV: 4.4%
Portugal	Ministèrio do ambiente e recursos naturais, Laboratorio de Santo Andre, Santo Andre	0.75%	

Table 3.8, cont.:

Sulphate in precipitation			
Country / site	Laboratory	Laboratory precision	Measurement precision
Russian Federation	Institute of Global Climate and Ecology, Moscow		RU1:M.MAD=0.01 μg S/m3 and CoV =2.8%. Ru13: M.MAD=0.021 μg S/m3 and CoV =3.8 %. RU16, M.MAD=0.021 μg S/m3 and CoV =2% RU20: M.MAD=0.021 μg N/m3 and CoV =3.9%
Slovakia	Slovak Hydrometeorological Institute, Bratislava	c=4 mg S/l; 0.5% c=2 mg S/l; 1-2 %	
Slovenia	Hydrometeorological Inst. of Slovenia, Ljubljana	4.9%	0.009 mg S/l
Spain	Inst. de Salud Carlos III	1.4%	
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	2%	CoV = 4%
Switzerland	Swiss Fed. Lab. for Mat. testing and Research		M.MAD: 0.04 mg S/l
Turkey	Refik Saydam Centre of Hygiene, Ankara	M.MAD: 0.002 mg N/l CoV: 0.23 %	
United Kingdom	AEA Technology, Culham	2%	

Table 3.9:

Potassium in precipitation			
Country / site	Laboratory	Laboratory precision	Method precision
Austria	Umweltbundesamt, Klagenfurt	2.3 % RSD	13 % RSD
Commission of European Communities	Joint Research Centre, Ispra Establishment	0.16 mg K/l (from 1996)	
Czech Republic	Czech Hydrometeorological Institute, Prague	2.2% RSD	M.MAD: 0.019 mg K/l CoV=21%
Estonia	Estonian Environmental Research Centre, Tallinn	3%	
Finland	Finnish Meteorological Institute, Helsingfors	c= 0.12 mg K/l; 6% c= 36 mg K/l; 3.6%	
France	l'Ecole des Mines de Douai, Laboratoire Wolff, Douai	c< 0.2 mg K/l; 10-20% c= 0.2-0.5 mg K/l; 5-10% c= 0.5-5 mg K/l; 1-5%	
Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	<5% RSD	
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome	c=0.5 mg K/l; 1.4% RSD c=0.05 mg K/l; 2.8% RSD	c=1 mg K/l; 1.2% RSD
Latvia	Latvian Hydrometerological Agency, Riga	12% RSD	
Netherlands	National Institute for Public Health and Environmental Protection (RIVM), Bilthoven	c= 0.27-0.39 mg K/l; 5% RSD c= 0.39-0.59 mg K/l; 4% RSD c= 0.59-0.78 mg K/l; 3% RSD c= 0.78-1.95 mg K/l; 2% RSD c= >1.95 mg K/l; 1.5% RSD (from 1997)	
Norway	Norwegian Institute for Air Research, Kjeller	c=0.61 µg K/ml: 4.4% RSD c=0.2 µg K/ml; 7.5% RSD	
Poland	Institute of Meteorology and Water Management, Warsaw	c=0.5 mg K/l; 1.7%RSD c= 0.05 mg K/l; 7.6%RSD	
	Institute of Environmental Protection, Warsaw (PL5)	M.MAD: 0.004 mg K/l CoV: 5.2%	M.MAD: 0.055mg K/l CoV: 29.8%
Portugal	Ministèrio do ambiente e recursos naturais, Laboratorio de Santo Andre, Santo Andre	1.7%	
Russian Federation	Institute of Global Climate and Ecology, Moscow		RU1:M.MAD = 0.031 µg K/m3 and CoV = 8.2%. Ru13: M.MAD = 0.031 µg K/m3 and CoV = 7.2 %. RU16: M.MAD = 0.021 µg S/m3 and CoV = 5.1% RU20: M.MAD = 0.021 µg N/m3 and CoV = 7.1%

Table 3.9, cont.:

Potassium in precipitation			
Country / site	Laboratory	Laboratory precision	Method precision
Slovakia	Slovak Hydrometeorological Institute, Bratislava	c=0.2 mg K/l; 2.3%RSD	
Spain	Instituto de Salud Carlos III	18%	
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	8%	CoV = 14%
Switzerland	Swiss Fed. Lab. for Materials testing and Research		M.MAD: 0.01 mg K/l
Turkey	Refik Saydam Centre of Hygiene, Ankara	M.MAD: 0.009 mg K/l; CoV: 4.3 %	
United Kingdom	AEA Technology, Culham	6%	

Table 3.10:

Ammonium in precipitation			
Country / site	Laboratory	Laboratory precision	Method precision
Austria	Umweltbundesamt, Klagenfurt	3.7 % RSD	
Czech Republic	Czech Hydrometeorological Institute, Prague	6.3 % RSD	M.MAD: 0.094 mg N/l; CoV= 6.1%
Denmark	National Environmental Research Institute, Roskilde	M.MAD: 0.01 mg N/l CoV: 1.9 %	
Estonia	Estonian Environmental Research Centre, Tallinn	6%	
Finland	Finnish Meteorological nstitute, Helsingfors	c= 0.23 mg N/l; 2.6% c= 0.70 mg N/l; 2.8%	
France	l'Ecole des Mines de Douai, Laboratoire Wolff, Douai	c< 0.2 mg N/l; 5-10% c= 0.2-0.5 mg N/l; 3-5% c= 0.5-5 mg N/l; 1-3%	
Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	5-10 % RSD	
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome	c=0.5 mg N/l; 0.5% RSD c=0.05 mg N/l; 1.9% RSD	c= 0.5 mg N/l; 0.8% RSD
Latvia	Latvian Hydrometerological Agency, Riga	9% RSD	
Lithuania	Institute of Physics, Vilnius	c<0.1 mg N/l; 4.8 % RSD	
Netherlands	National Institute for Public Health and Environmental Protection (RIVM), Bilthoven	RSD=(0.76 + 1115.6/c2) 1/2%; c= 0.35-42 mg N/l; 1.5% RSD (from 1997)	
Norway	Norwegian Institute for Air Research, Kjeller	c=0.64 µg N/ml: 2.5% RSD c=0.32 µg N/ml: 4.1% RSD	
Poland	Institute of Meteorology and Water Management, Warsaw	c= 0.972 mg N/l; 2.7% c= 0.097 mg N/l; 4.6%	
	Institute of Environmental Protection, Warsaw (PL5)	M.MAD: 0.05 mg N/l CoV: 15.1%	M.MAD: 0.055 mg N/l CoV: 14%
Portugal	Ministèrio do ambiente e recursos naturais, Laboratorio de Santo Andre, Santo Andre	0.79%	
Russian Federation	Institute of Global Climate and Ecology, Moscow		M.MAD=0.01 µg N/m3 CoV =6.5%
Slovakia	Slovak Hydrometeorological Institute, Bratislava	c=2 mg N/l; 2.3%	
Slovenia	Hydrometeorological Institute of Slovenia, Ljubljana	4.6%	
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	3%	CoV = 3%
Spain	Instituto de Salud Carlos III	2.7%	
Switzerland	Swiss Fed. Lab. for Materials testing and Research		M.MAD: 0.02 mg N/l
Turkey	Refik Saydam Centre of Hygiene, Ankara	M.MAD 0.004 mgN/l; CoV: 0.73%	
United Kingdom	AEA Technology, Culham Abington	10%	

Table 3.11:

Calcium in precipitation			
Country / site	Laboratory	Laboratory precision	Method precision
Austria	Umweltbundesamt, Klagenfurt	2% RSD	
Commission of European Com	Joint Research Centre, Ispra Establishment	0.54 mg Ca/l (from 1996)	
Czech Republic	Czech Hydrometeorological Institute, Prague	5.8 % RSD	M.MAD: 0.036 mg Ca/l; CoV=8.1%
Estonia	Estonian Environmental Research Centre, Tallinn	1%	
Finland	Finnish Meteorological Institute, Helsingfors	c= 0.20 mg Ca/l; 4.9% c= 0.61 mg Ca/l; 1.8 %	
France	l'Ecole des Mines de Douai, Laboratoire Wolff, Douai	c< 0.2 mg Ca/l; 10-20% c= 0.2-0.5 mg Ca/l; 5-10% c= 0.5-5 mg Ca/l; 1-5%	
Hungary	Inst. for Atmosph. Physics	< 5% RSD	
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome	c=0.5 mg Ca/l; 0.2% RSD c=0.05 mg Ca/l; 3.3% RSD	c= 1 mg Ca/l; 1.6% RSD
Latvia	Latvian Hydrometerological Agency, Riga	9% RSD	
Netherlands	National Institute for Public Health and Environmental Protection (RIVM), Bilthoven		c= 0.08-0.12 mg Ca/l; 5% RSD c= 0.12-0.18 mg Ca/l; 4% RSD c= 0.18-0.24 mg Ca/l; 3% RSD c= 0.24-0.60 mg Ca/l; 2% RSD c= >0.60 mg Ca/l; 1.5% RSD (from 1997)
Norway	Norwegian Institute for Air Research, Kjeller	c=0.27 µg Ca/ml:3.7% RSD c=0.15 µg Ca/ml: 4.0%RSD	
Poland	Institute of Meteorology and Water Management, Warsaw	c= 2 mg Ca/l; 1.2% RSD c=0.2 mg Ca/l; 6.4% RSD	
	Institute of Environmental Protection, Warsaw (PL5)	M.MAD: 0.005 mg Ca/l CoV: 3.4%	M.MAD: 0.019mg Ca/l CoV: 12.2%
Portugal	Ministèrio do ambiente e recursos naturais, Laboratorio de Santo Andre, Santo Andre	1.31%	
Russian Federation	Inst. of Global Climate and Ecology,		RU1:M.MAD= 0.016 µg Ca /m3 and CoV =9.8%. Ru13: M.MAD = 0.042 µg Ca/m3 and CoV =15.8 %. RU16: M.MAD = 0.021 µg Ca/m3 and CoV =2.3% RU20: M.MAD = 063 µg Ca/m3 and CoV =16.8%

Table 3.11, cont.:

Calcium in precipitation			
Country / site	Laboratory	Laboratory precision	Method precision
Slovakia	Slovak Hydrometeorological Institute, Bratislava	c=0.1 mg Ca/l; 5% RSD	
Spain	Inst de Salud Carlos III	7.4%	
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	5%	CoV = 4%
Switzerland	Swiss Fed. Lab. for Mat. testing and Research		M.MAD: 0.02 mg Ca/l
Turkey	Refik Saydam Centre of Hygiene, Ankara	M.MAD 0.21 mgCa/l; CoV: 14.7%	
United Kingdom	AEA Technology, Culham	5%	

Table 3.12:

Magnesium in precipitation			
Country / site	Laboratory	Laboratory precision	Method precision
Austria	Umweltbundesamt, Klagenfurt	1.2% RSD	
Commission of European Com	Joint Research Centre, Ispra Establishment	0.13 mg Mg/l (from 1996)	
Czech Republic	Czech Hydrometeorological Institute, Prague	1.9 % RSD	M.MAD: 0.004 mg Mg/l; CoV=8.6%
Estonia	Estonian Environmental Research Centre, Tallinn	1%	
Finland	Finnish Meteorological Institute, Helsingfors	c= 0.04 mg Mg/l; 4.5% c= 0.66 mg Mg/l; 1.7%	
France	l'Ecole des Mines de Douai, Laboratoire Wolff, Douai	c< 0.2 mg Mg/l; 10-20% c= 0.2-0.5 mg Mg/l; 5-10% c= 0.5-5 mg Mg/l; 1-5%	
Hungary	Institute for Atmospheric Physics, Budapest	<5% RSD	
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome	c= 0.5 mg Mg/l; 0.7%RSD c= 0.05 mg Mg/l; 3.3%RSD	c= 0.5 mg Mg/l; 1.0% RSD
Latvia	Latvian Hydrometerological Agency, Riga	10% RSD	
Netherlands	National Institute for Public Health and Environmental Protection (RIVM), Bilthoven		c= 0.25-0.36 mg Mg/l; 5% RSD c= 0.36-0.54 mg Mg/l; 4% RSD c= 0.54-0.72 mg Mg/l; 3% RSD c= 0.72-1.8 mg Mg/l; 2% RSD c= >1.8 mg Mg/l; 1.5% RSD (from 1997)
Norway	Norwegian Institute for Air Research, Kjeller	c=0.31 µg Mg/ml: 3.9%RSD c=0.19 µg Mg/ml: 3.7%RSD	
Poland	Institute of Meteorology and Water Management, Warsaw	c= 0.25mg Mg/l; 0.5% RSD c= 0.025 mg Mg/l; 4.3%RSD	
	Institute of Environmental Protection, Warsaw (PL5)	M.MAD: 0.002 mg Mg/l CoV: 5.9%	M.MAD: 0.007 mg Mg/l; CoV: 11.0%
Portugal	Ministèrio do ambiente e recursos naturais, Laboratorio de Santo Andre, Santo Andre	0.60%	
Russian Federation	Institute of Global Climate and Ecology, Moscow		RU1: M.MAD= 0.001 µg Mg/m3 and CoV =9.9%. Ru13: M.MAD = 0.003 µg Mg/m3 and CoV =3.9 %. RU16, M.MAD = 0.004 µg S/m3 and CoV =2.4%

Table 3.12, cont.:

Magnesium in precipitation			
Country / site	Laboratory	Laboratory precision	Method precision
Slovakia	Slovak Hydrometeorological Institute, Bratislava	c=0.05 mg Mg/l; 1.9%	
Spain	Instituto de Salud Carlos III	7.2%	
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	3%	CoV = 2%
Switzerland	Swiss Fed. Lab. for Materials testing and Research		M.MAD: 0.01 mg Mg/l
Turkey	Refik Saydam Centre of Hygiene, Ankara	M.MAD 0.002 mgCa/l; CoV: 2.1%	
United Kingdom	AEA Technology, Culham Abington	3.50%	

Table 3.13:

Sodium in precipitation			
Country / site	Laboratory	Laboratory precision	Method precision
Austria	Umweltbundesamt, Klagenfurt	1.2 %RSD	
Commission of European Com.	Joint Research Centre, Ispra Establishment	0.14 Na/l (from 1996)	
Czech Republic	Czech Hydrometeorological Institute, Prague	1.2 % RSD	M.MAD: 0.016 mg Na/l; CoV = 10.3%
Estonia	Estonian Environmental Research Centre, Tallinn	3%	
Finland	Finnish Meteorological Institute, Helsingfors	c= 0.22 mg Na/l; 5.7% c= 0.66 mg Na/l; 1.7%	
France	l'Ecole des Mines de Douai, Laboratoire Wolff, Douai	c< 0.2 mg Na/l; 10-20 % c= 0.2-0.5 mg Na/l; 5-10% c= 0.5-5 mg Na/l; 1-5%	-
Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	<5% RSD	
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome	c=0.5 mg Na/l; 1.2% RSD c=0.05 mg Na/l; 2.4% RSD	c=0.5 mg Na/l; 0.8% RSD
Latvia	Latvian Hydrometerological Agency, Riga	11% RSD	
Netherlands	National Institute for Public Health and Environmental Protection (RIVM), Bilthoven	c= 0.25-0.35 mg Na/l; 5% RSD c= 0.35-0.52 mg Na/l; 4% RSD c= 0.52-0.69 mg Na/l; 3% RSD c= 0.69-1.72 mg Na/l; 2% RSD c> 1.72 mg Na/l; 1.5% RSD (from 1997)	
Norway	Norwegian Institute for Air Research, Kjeller	c=0.75 µg Na/ml: 3.3% RSD c=0.3 µg Na/ml: 3.7% RSD	
Poland	Institute of Meteorology and Water Management, Warsaw	c= 1.0 mg Na/l; 0.9% RSD c= 0.1 mg Na/l; 4.3% RSD	
	Institute of Environmental Protection, Warsaw (PL5)	M.MAD: 0.004 mg Na/l CoV: 7.5%	M.MAD: 0.018 mg Na/l CoV: 10.5%
Portugal	Ministèrio do ambiente e recursos naturais, Laboratorio de Santo Andre, Santo Andre	0.54%	
Russian Federation	Institute of Global Climate and Ecology, Moscow		RU1: M.MAD= 0.021 µg Na/m3 and CoV = 4.2%. Ru13: M.MAD = 0.01 µg Na/m3 and CoV =2.7 %. RU16, M.MAD = 0.021 µg Na/m3 and CoV =1.9% RU20, M.MAD = 0.021 µg Na/m3 and CoV =7.1%

Table 3.13, cont.:

Sodium in precipitation			
Country / site	Laboratory	Laboratory precision	Method precision
Slovakia	Slovak Hydrometeorological Institute, Bratislava	c=0.2 mg Na/l; 2.7%	
Spain	Inst. de Salud Carlos III	14%	
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	4%	CoV = 12%
Switzerland	Swiss Fed. Lab. for Materials testing and Research		M.MAD: 0.02 mg Na/l
Turkey	Refik Saydam Centre of Hygiene, Ankara	M.MAD 0.007 mgNa/l; CoV: 1.7%	
United Kingdom	AEA Technology, Culham Abington	3.50%	

Table 3.14:

Chloride in precipitation			
Country / site	Laboratory	Laboratory precision	Method precision
Austria	Umweltbundesamt, Klagenfurt	3.5% RSD	
Commission of European Com.	Joint Research Centre, Ispra Establishment	0.21 mg Cl/l (from 1996)	
Czech Republic	Czech Hydrometeorological Institute, Prague	1.1 % RSD	M.MAD: 0.06 mg Cl/l; CoV = 18.7%
Denmark	National Environmental Research Institute, Roskilde	M.MAD: 0.06 mg Cl/l CoV: 1.32%	
Estonia	Estonian Environmental Research Centre, Tallinn	1%	
Finland	Finnish Meteorological Institute, Helsingfors	c= 0.5 mg Cl/l; 3.2% RSD c= 1.2 mg Cl/l; 2.3% RSD	
France	l'Ecole des Mines de Douai, Laboratoire Wolff, Douai	c< 0.2 mg Cl/l; 10-20% c= 0.2-0.5 mg Cl/l; 5-10% c= 0.5-5 mg Cl/l; 1-5%	
Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	<10% RSD	
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome	c= 0.5 mg Cl/l; 0.6% RSD c= 0.05 mg Cl/l; 1.0% RSD	c=0.5 mg Cl/l; 0.8% RSD
Latvia	Latvian Hydrometerological Agency, Riga	14% RSD	
Lithuania	Institute of Physics, Vilnius	c<0.5 mg Cl/l; 4.5% RSD c>0.5 mg Cl/l; 2.3% RSD	c<0.5 mg Cl/l; 4.5% RSD c>0.5 mg Cl/l; 2.3% RSD
Norway	Norwegian Institute for Air Research, Kjeller	c=1.16 µg Cl/ml; 2.4% RSD c=0.46 µg Cl/ml; 4.4% RSD	
Poland	Institute of Meteorology and Water Management, Warsaw	c= 10 mg Cl/l; 0.6% RSD c= 1 mg Cl/l; 1.2% RSD c= 0.5 mg Cl/l; 1.3%RSD	
	Institute of Environmental Protection, Warsaw (PL5)	M.MAD = 0.08 mg Cl/l CoV = 20.2%	M.MAD: 0.101 mg Cl/l CoV: 13.1%
Portugal	Ministèrio do ambiente e recursos naturais, Laboratorio de Santo Andre, Santo Andre	0.53%	
Russian Federation	Institute of Global Climate and Ecology, Moscow		RU1: M.MAD= 0.089 µg Cl/m3 and CoV = 11.2%. Ru13: M.MAD = 0.073 µg Cl/m3 and CoV =9.5 %. RU16, M.MAD = 0.017 µg Cl/m3 and CoV =7.9% RU20, M.MAD = 0.042 µg Cl/m3 and CoV =12.3%

Table 3.14, cont.:

Chloride in precipitation			
Country / site	Laboratory	Laboratory precision	Method precision
Slovakia	Slovak Hydrometeorological Institute, Bratislava	c=0.9 mg Cl/l; 5.4%	
Spain	Instituto de Salud Carlos III	4.9%	
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	2%	CoV = 6%
Switzerland	Swiss Fed. Lab. for Materials testing and Research		M.MAD: 0.02 mg Cl/m3
Turkey	Refik Saydam Centre of Hygiene, Ankara	M.MAD: 0.006 mg Cl/l CoV: 2.1%	
United Kingdom	AEA Technology, Culham Abington	3%	

Table 3.15:

Ozone		
Country / site	Laboratory	Method lower limit
Commission of European Communities	Joint Research Centre, Ispra Establishment	4 µg/m3 (from 1996)
Denmark	National Environmental Research Institute, Roskilde	1 ppb
Estonia	Estonian Environmental Research Centre, Tallinn	2 µg/m3
Finland	Finnish Meteorological Institute, Helsingfors	2 µg/m3
France	l'Ecole des Mines de Douai, Laboratoire Wolff, Douai	2 µg/m3
Germany	Umweltbundesamt, Messtelle Schauinsland	2 µg/m3
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome	1 µg /m3
Norway	Norwegian Institute for Air Research, Kjeller	2 µg/m3
Poland	Institute of Meteorology and Water Management, Warsaw	2 µg/m3
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	4 µg/m3 and 1 µg/m3 (from 1997)
Switzerland	Swiss Federal Laboratory of Testing Materials and Research (EMPA), Dübendorf	2 µg/m3

Table 3.16:

Nitrogen dioxide			
Country / site	Laboratory	Laboratory lower limit	Method lower limit
Commission of European Communities	Joint Research Centre, Ispra Establishment		0.3 µg N/m3 (from 1996)
Czech Republic	Czech Hydrometeorological Institute, Prague	0.001 mg/l	0.07 µg N/m3
Denmark	National Environmental Research Institute, Roskilde	0.01 mg N/l	DK8: 0.003 µg N/m3
Estonia	Estonian Environmental Research Centre, Tallinn		0.01 µg/m3
Finland	Finnish Meteorological Institute, Helsingfors		0.3 µg N/m3
Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	~0.15 µg N/m3	<0.25 µg N/m3
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome		0.3 µg N/m3
Latvia	Latvian Hydrometerological Agency, Riga	0.1 mg N/l	0.1 – 0.2 µg N/m3
Lithuania	Institute of Physics, Vilnius	0.02 mg N/l	0.08 µg N/m3
Norway	Norwegian Institute for Air Research, Kjeller	0.0045 mg N/l	
Poland	Institute of Meteorology and Water Management, Warsaw	0.008 mg N/l	0.2 µg N/m3
	Institute of Environmental Protection, Warsaw (PL5)	0.002 mg N/l	0.1 µg N/m3
Spain	Instituto de Salud Carlos III	1 µg N/sample	1 µg N/m3
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	0. 048 mg N/l	0.2 µg N/m3
Switzerland	Swiss Federal Laboratory of Testing Materials and Research (EMPA), Dübendorf		CH4: 0.5 ppb; CH5: 0.5ppb; CH2, CH3: 1 ppb; CH1: 0.05 ppb;
Yugoslavia	Federal Hydrometeorological Institute, Belgrade	0.003 mg N02/l	
Turkey	Refik Saydam Centre of Hygiene, Ankara	0.2 µg N/sample	

Table 3.17:

Sulphur dioxide			
Country / site	Laboratory	Laboratory lower limit	Method lower limit
Commission of European Communities	Joint Research Centre, Ispra Establishment		1.3 µg S/m3 (from 1996)
Czech Republic	Czech Hydrometeorological Institute, Prague	0.1 mg S/l	0.1 µg S/m3
Denmark	National Environmental Research Institute, Roskilde	0.02 mg S/l	DK3: 0.04 µg S/m3 DK5: 0.05 µg S/m3 DK8: 0.05 µg S/m3
Estonia	Estonian Environmental Research Centre, Tallinn		0.03 µg S/m3
Finland	Finnish Meteorological Institute, Helsingfors	0.05 mg S/l	
France	l'Ecole des Mines de Douai, Laboratoire Wolff, Douai	0.1 mg S/l	
Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	ca. 0.03 µg S/m3	< 0,01 µg S/m3
Ireland	Meteorological Service H.Q., Dublin		0.1 µg S/m3 (1996)
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome		0.10 µg S/m3
Latvia	Latvian Hydrometerological Agency, Riga		0.2-0.5 µg S/m3
Lithuania	Institute of Physics, Vilnius	0.02 mg S/l	0.01 µg S/m3
Norway	Norwegian Institute for Air Research, Kjeller		0.03 µg S/m3
Poland	Institute of Meteorology and Water Management, Warsaw	0.04 mg S/l	0.2 µg S/m3
	Institute of Environmental Protection, Warsaw (PL5)	0.04 mg S/l	0.1 µg S/m3
Russian Federation	Institute of Global Climate and Ecology, Moscow		RU1: 0.06 µg S/m3; RU16: 0.11 µg S/m3 RU20: 0.10 µg S/m3
Slovakia	Slovak Hydrometeorological Institute, Bratislava		0.02 µg S/m3
Slovenia	Hydrometeorological Institute of Slovenia, Ljubljana		0.06 µg S/m3
Spain	Instituto de Salud Carlos III	1 µg S/sample	0.5 µg S/m3
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	0.004 mg S/l	0.02 µg S/m3
Switzerland	Swiss Federal Laboratory of Testing Materials and Research (EMPA), Dübendorf		0.04 µg S / m3 monitors: CH2, CH3: 1 ppb; CH4, CH5: 0.2 ppb;
Turkey	Refik Saydam Centre of Hygiene, Ankara	3.1 µg S/sample	
Yugoslavia	Federal Hydrometeorological Institute, Belgrade	0.005 mg S/l	

Table 3.18:

Sulphate in air			
Country / site	Laboratory	Laboratory lower limit	Method lower limit
Czech Republic	Czech Hydrometeorological Institute, Prague	0.3 mg S/filter	0.03 µg S/m3
Denmark	National Environmental Research Institute, Roskilde		0.02 µg S/m3
Finland	Finnish Meteorological Institute, Helsingfors	0.02 mg S/l	
France	l'Ecole des Mines de Douai, Laboratoire Wolff, Douai	0.2 µg S/filter	
Ireland	Meteorological Service H.Q., Dublin		0.03 µg S/m3 (1996)
Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	ca.0.03 µg S/m3	<0.1 µg S/m3
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome		0.01 µg S/m3
Latvia	Latvian Hydrometerological Agency, Riga	0.2 mg S/l	0.13 – 0.20 µg S/m3
Lithuania	Institute of Physics, Vilnius	0.02 mg S/l	0.025 µg S/m3
Norway	Norwegian Institute for Air Research, Kjeller		0.01 µg S/m3
Poland	Institute of Meteorology and Water Management, Warsaw	0.04 mg S/l	0.2 µg S/m3
	Institute of Environmental Protection, Warsaw (PL5)	0.04 mg S/l	0.1 µg S/m3
Russian Federation	Institute of Global Climate and Ecology, Moscow		RU1: 0.05 µg S/m3 RU16: 0.1 µg S/m3 RU20:0.09 µg S/m3
Slovakia	Slovak Hydrometeorological Institute, Bratislava		0.09 µg S/m3
Slovenia	Hydrometeorological Institute of Slovenia, Ljubljana		0.023 mg S/l
Spain	Instituto de Salud Carlos III	3.5 µg S/sample	0.01 µg S/m3
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	0.005 mg S/l	0.005 µg S/m3
Switzerland	Swiss Federal Laboratory of Testing Materials and Research (EMPA), Dübendorf		0.04 µg S/m3
Turkey	Refik Saydam Centre of Hygiene, Ankara	0.5 µg S/sample	
United Kingdom	AEA Technology, Culham Abington	0.01 mg S/l	

Table 3.19:

Nitrate + nitric acid in air			
Country / site	Laboratory	Laboratory lower limit	Method lower limit
Denmark	National Environmental Research Institute, Roskilde	NO3: 0.02 mg N/l HNO3: 0.02 mg N/l	DK3: 0.05 µg N/m3 DK5, DK8: 0.06 µg N/m3
Finland	Finnish Meteorological Institute, Helsingfors	NO3: 0.01 mg N/l HNO3: 0.03 mg N/l	
Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	0.03 µg N/m3	< 0.1 µg N/m3
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome		0.01 µg N/m3
Latvia	Latvian Hydrometerological Agency, Riga	NO3: 0.2 mg N/l	NO3: 0.01-0.04 µg N/m3
Lithuania	Institute of Physics, Vilnius	0.02 mg N/l	0.01 µg N/m3
Norway	Norwegian Institute for Air Research, Kjeller		0.02 µg N/m3
Poland	Institute of Meteorology and Water Management, Warsaw	0.01 µg N/ml	0.02 µg N/m3
	Institute of Environmental Protection, Warsaw (PL5)	0.05 mg N/l	0.2 µg N/m3
Russian Federation	Institute of Global Climate and Ecology, Moscow		NO3: RU1, RU20: 0.03 µg N/m3; RU13: 0.04 µg N/m3
Slovakia	Slovak Hydrometeorological Institute, Bratislava		NO3: 0.025 µg N/m3 HNO3: 0.02 µg N/m3
Slovenia	Hydrometeorological Institute of Slovenia, Ljubljana		NO3: 0. 025 µg N/m3 HNO3: 0.22 µg N/m3 jan-jun, 0.025 µg N/m3 jul-dec
Spain	Instituto de Salud Carlos III	2µg N/sample	0.05 µg N/m3
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	NO3: 0.002 mg N/l HNO3: 0.005 mg N/l	NO3: 0.002 µg N/m3
Switzerland	Swiss Federal Laboratory of Testing Materials and Research (EMPA), Dübendorf		0.02 µg N/m3
Turkey	Refik Saydam Centre of Hygiene, Ankara	NO3: 0.9 µg N/sample HNO3: 0.5 µg N/sample	

Table 3.20:

Ammonia + ammonium in air			
Country / site	Laboratory	Laboratory lower limit	Method lower limit
Denmark	National Environmental Research Institute, Roskilde	0.02 mg N/l	DK3:0.06 µg N/m3 DK5:0.05 µg N/m3 DK8:0.04 µg N/m3
Finland	Finnish Meteorological Institute, Helsingfors	0.02 mg N/l	
Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	0.04 mg N/l	NH3: ca.0,05 µg N/m3 NH4: <0.1 µg N/m3
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome		0.1 µg N/m3
Latvia	Latvian Hydrometerological Agency, Riga	NH4: 0.04 mg N/l	NH4: 0.12-0.21 µg N/m3
Lithuania	Institute of Physics, Vilnius	0.04 mg N/l	0.03 µg N/m3
Norway	Norwegian Institute for Air Research, Kjeller		0.05 µg N/m3
Poland	Institute of Meteorology and Water Management, Warsaw	0.03 mg N/l	0.06 µg N/m3
	Institute of Environmental Protection, Warsaw (PL5)	0.01 mg N/l	0.03 µg N/m3
Russian Federation	Institute of Global Climate and Ecology, Moscow		RU1: 0.07 NH3: RU16: 0.34 µg N/m3; RU20: 0.20 µg N/m3
Slovenia	Hydrometeorological Institute of Slovenia, Ljubljana		NH4: 0. 02 µg N/m3 NH3: 0.32 µg N/m3 jan-jun, 0.04 µg N/m3 jul-dec
Spain	Instituto de Salud Carlos III	1 µg N/sample	0.03 µg N/m3
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	NH4: 0.017 mg N/l NH3: 0.03 mg N/l	0.03 µg N/m3
Switzerland	Swiss Federal Laboratory of Testing Materials and Research (EMPA), Dübendorf		0.2 µg N/m3
Turkey	Refik Saydam Centre of Hygiene, Ankara	NH3: 2.1 µg N/sample NH4: 1.5 µg N/sample	

Table 3.21:

Nitrate in precipitation			
Country / site	Laboratory	Laboratory lower limit	Method lower limit
Austria	Umweltbundesamt, Klagenfurt	0.002 mg N/l	0.005 mg N/l
Czech Republic	Czech Hydrometeorological Institute, Prague	0.03 mg N/l	
Denmark	National Environmental Research Institute, Roskilde	0.04 mg N/l	
Estonia	Estonian Environmental Research Centre, Tallinn	0.02 mg N/l	
Finland	Finnish Meteorological Institute, Helsingfors	0.01 mg N/l	
France	l'Ecole des Mines de Douai, Laboratoire Wolff, Douai	0.02 mg N/l	
Germany	Umweltbundesamt, Messtelle Schauinsland	0.01 mg N/l	
Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	ca.0.03 mg N/l	
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome	0.002 mg N/l	0.01 mg N/l
Latvia	Latvian Hydrometerological Agency, Riga	0.1 mg N/l	
Lithuania	Institute of Physics, Vilnius	0.02 mg N/l	0.04 mg N/l
Netherlands	National Institute for Public Health and Environmental Protection (RIVM), Bilthoven	0.028 mg N/l (from (1997)	
Norway	Norwegian Institute for Air Research, Kjeller	0.01 mg N/l	
Poland	Institute of Meteorology and Water Management, Warsaw	0.01 mg N/l	
	Institute of Environmental Protection, Warsaw (PL5)	0.05 mg N/l	
Portugal	Ministèrio do ambiente e recursos naturais, Laboratorio de Santo Andre, Santo Andre	0.09 mg N/l	
Russian Federation	Institute of Global Climate and Ecology, Moscow	0.01 mg N/l	
Slovakia	Slovak Hydrometeorological Institute, Bratislava	0.01 mg N/l	0.05 mg N/l
Slovenia	Hydrometeorological Institute of Slovenia, Ljubljana	0.015 mg N/l	
Spain	Instituto de Salud Carlos III	0.08 mg N/l	
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	0.002 mg N/l	
Switzerland	Swiss Federal Laboratory of Testing Materials and Research (EMPA), Dübendorf	0.02 mg N/l	
Turkey	Refik Saydam Centre of Hygiene, Ankara	0.9 µg N/sample	
United Kingdom	AEA Technology, Culham Abington	0.03 mg N/l	
Yugoslavia	Federal Hydrometeorological Institute, Belgrade	0.02 mg N/l	

Table 3.22:

Sulphate in precipitation			
Country / site	Laboratory	Laboratory lower limit	Method lower limit
Austria	Umweltbundesamt, Klagenfurt	0.01 mg S/l	
Czech Republic	Czech Hydrometeorological Institute, Prague	0.02 mg S/l	
Denmark	National Environmental Research Institute, Roskilde	0.01 mg S/l	
Estonia	Estonian Environmental Research Centre, Tallinn	0.1 mg S/l	
Finland	Finnish Meteorological Institute, Helsingfors	0.02 mg S/l	
France	l'Ecole des Mines de Douai, Laboratoire Wolff, Douai	0.02 mg S/l	
Germany	Umweltbundesamt, Messtelle Schauinsland	0.01 mg S/l	
Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	ca.0.03 mg S/l	
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome	0.002 mg S/l	0.01 mg S/l
Latvia	Latvian Hydrometerological Agency, Riga	0.15 mg S/l	
Lithuania	Institute of Physics, Vilnius	0.02 mg S/l	0.1 mg S/l
Netherlands	National Institute for Public Health and Environmental Protection (RIVM), Bilthoven	0.032 mg S/l (from 1997)	
Norway	Norwegian Institute for Air Research, Kjeller	0.01 mg S/l	
Poland	Institute of Meteorology and Water Management, Warsaw	0.04 mg S/l	
	Institute of Environmental Protection, Warsaw (PL5)	0.05 mg S/l	
Portugal	Ministèrio do ambiente e recursos naturais, Laboratorio de Santo Andre, Santo Andre	0.15 mg S/l	
Russian Federation	Institute of Global Climate and Ecology, Moscow	0.02 mg S/l	
Slovakia	Slovak Hydrometeorological Institute, Bratislava	0.01 mg S/l	0.07 mg S/l
Slovenia	Hydrometeorological Institute of Slovenia, Ljubljana	0.023 mg/l	
Spain	Instituto de Salud Carlos III	0.07 mg S/l	
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	0.004 mg S/l	
Switzerland	Swiss Federal Laboratory of Testing Materials and Research (EMPA), Dübendorf	0.03 mg S/l	
United Kingdom	AEA Technology, Culham Abington	0.04 mg S/l	
Yugoslavia	Federal Hydrometeorological Institute, Belgrade	0.16 mg S/l	
Turkey	Refik Saydam Centre of Hygiene, Ankara	0.5 µg S/sample	

Table 3.23:

Potassium in precipitation			
Country / site	Laboratory	Laboratory lower limit	Method lower limit
Austria	Umweltbundesamt, Klagenfurt	0.018 mg K/l	
Commission of European Com.	Joint Research Centre, Ispra Establishment		0.07 mg K/l (from 1996)
Czech Republic	Czech Hydrometeorological Institute, Prague	0.003 mg K/l	0.03 mg K/l
Estonia	Estonian Environmental Research Centre, Tallinn	0.1 mg K/l	
Finland	Finnish Meteorological Institute, Helsingfors	0.006 mg K/l	
France	l'Ecole des Mines de Douai, Laboratoire Wolff, Douai	0.02 mg K/l	
Germany	Umweltbundesamt, Messtelle Schauinsland	0.01 mg K/l	
Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	ca. 0.01 mg K/l	
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome	0.002 mg K/l	0.01 mg K/l
Latvia	Latvian Hydrometerological Agency, Riga	0.012 mg K/l	
Lithuania	Institute of Physics, Vilnius	0.02 mg K/l	
Netherlands	National Inst. for Public Health and Env. Protection, Bilthoven	0.039 mg K/l (from 1997)	
Norway	Norwegian Institute for Air Research, Kjeller	0.01 mg K/l	
Poland	Institute of Meteorology and Water Management, Warsaw	0.02 mg K/l	
	Institute of Environmental Protection, Warsaw (PL5)	0.003 mg K/l	
Portugal	Ministèrio do ambiente e recursos naturais, Laboratorio de Santo Andre, Santo Andre	0.077 mg K/l	
Russian Federation	Institute of Global Climate and Ecology, Moscow	0.03 mg K/l	
Slovakia	Slovak Hydrometeorological Institute, Bratislava	0.01 mg K/l	0.02 mg K/l
Spain	Instituto de Salud Carlos III	0.05 mg K/l	
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	0.05 mg K/l	
Switzerland	Swiss Federal Lab. of Testing Mat. and Research Dübendorf	0.01 mg K/l	
United Kingdom	AEA Technology, Culham	0.05 mg K/l	
Yugoslavia	Federal Hydrometeorological Institute, Belgrade	0.015 mg K/l	

Table 3.24:

Ammonium in precipitation			
Country / site	Laboratory	Laboratory lower limit	Method lower limit
Austria	Umweltbundesamt, Klagenfurt	0.023 mg N/l	
Commission of European Com.	Joint Research Centre, Ispra Establishment		0.13 mg N/l (from 1996)
Czech Republic	Czech Hydrometeorological Institute, Prague	0.02 mg N/l	0.011 mg N/l
Denmark	National Environmental Research Institute, Roskilde	0.02 mg N/l	
Estonia	Estonian Environmental Research Centre, Tallinn	0.01 mg N/l	
Finland	Finnish Meteorological Institute,	0.002 mg N/l	
France	l'Ecole des Mines de Douai, Laboratoire Wolff, Douai	0.03 mg N/l	
Germany	Umweltbundesamt, Messtelle Schauinsland	0.01 mg N/l	
Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	ca. 0.04 mg N/ml	
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome	0.001 mg N/l	0.005 mg N/l
Latvia	Latvian Hydrometerological Agency, Riga	0.03 mg N/l	
Lithuania	Institute of Physics, Vilnius	0.04 mg N/l	0.06 mg N/l
Netherlands	National Inst. for Public Health and Env. Protection, Bilthoven	0.014 mg N/l	
Norway	Norwegian Institute for Air Research, Kjeller	0.01 mg N/l	
Poland	Institute of Meteorology and Water Management, Warsaw	0.03 mg N/l	
	Institute of Environmental Protection, Warsaw (PL5)	0.01 mg N/l	
Portugal	Ministèrio do ambiente e recursos naturais, Laboratorio de Santo Andre, Santo Andre	0.04 mg N/l	
Russian Federation	Institute of Global Climate and Ecology, Moscow	0.02 mg N/l	
Slovakia	Slovak Hydrometeorological Institute, Bratislava	0.02 mg N/l	
Slovenia	Hydrometeorological Institute of Slovenia, Ljubljana	0.023 mg N/l	
Spain	Instituto de Salud Carlos III	0.08 mg N/l	
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	0.02 mg N/l	
Switzerland	Swiss Federal Laboratory of Testing Materials and Research (EMPA), Dübendorf	0.02 mg N/l	
Turkey	Refik Saydam Centre of Hygiene, Ankara	1.5 µg N/sample	
United Kingdom	AEA Technology, Culham	0.03 mg N/l	
Yugoslavia	Federal Hydrometeorological Inst., Belgrade	0.03 mg N/l	

Table 3.25:

Calcium in precipitation			
Country / site	Laboratory	Laboratory lower limit	Method lower limit
Austria	Umweltbundesamt, Klagenfurt	0.012 mg Ca/l	0.028 mg Ca/l
Commission of European Com	Joint Research Centre, Ispra Establishment		0.4 mg Ca/l (from 1996)
Czech Republic	Czech Hydrometeorological Institute, Prague	0.011 mg Ca/l	0.001 mg Ca/l
Estonia	Estonian Environmental Research Centre, Tallinn	2 mg Ca/l	
Finland	Finnish Meteorological Institute	0.005 mg Ca/l	
France	l'Ecole des Mines de Douai, Laboratoire Wolff, Douai	0.02 mg Ca/l	
Germany	Umweltbundesamt, Messtelle Schauinsland	0.01 mg Ca/l	
Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	Ca. 0.01 mg Ca/l	
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome	0.002 mg Ca/l	0.01 mg Ca/l
Latvia	Latvian Hydrometerological Agency, Riga	0.015 mg Ca/l	
Lithuania	Institute of Physics, Vilnius	0.02 mg Ca/l	
Netherlands	National Inst. for Public Health and Env. Protection, Bilthoven	0.012 mg Ca/l (from 1997)	
Norway	Norwegian Institute for Air Research, Kjeller	0.01 mg Ca/l	
Poland	Institute of Meteorology and Water Management, Warsaw	0.03 mg Ca/l	
	Institute of Environmental Protection, Warsaw (PL5)	0.001 mg Ca/l	
Portugal	Ministèrio do ambiente e recursos naturais, Laboratorio de Santo Andre, Santo Andre	0.06 mg Ca/l	
Russian Federation	Institute of Global Climate and Ecology, Moscow	0.05 mg Ca/l	
Slovakia	Slovak Hydrometeorological Institute, Bratislava	0.01 mg Ca/l	0.06 mg Ca/l
Spain	Instituto de Salud Carlos III	0.04 mg Ca/l	
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	0.04 mg Ca/l	0.05 mg Ca/l
Switzerland	Swiss Federal Laboratory of Testing Materials and Research (EMPA), Dübendorf	0.03 mg Ca/l	
United Kingdom	AEA Technology, Culham Abington	0.05 mg Ca/l	
Yugoslavia	Federal Hydrometeorological Institute, Belgrade	0.005 mg Ca/l	

Table 3.26:

Magnesium in precipitation			
Country / site	Laboratory	Laboratory lower limit	Method lower limit
Austria	Umweltbundesamt, Klagenfurt	0.008 mg Mg/l	0.035 mg Mg/l
Commission of European Communities	Joint Research Centre, Ispra Establishment		0.06 mg Mg/l (from 1996)
Czech Republic	Czech Hydrometeorological Institute, Prague	0.01 mg Mg/l	0.01 mg Mg/l
Estonia	Estonian Environmental Research Centre, Tallinn	1 mg Mg/l	
Finland	Finnish Meteorological Institute, Helsingfors	0.003 mg Mg/l	
France	l'Ecole des Mines de Douai, Laboratoire Wolff, Douai	0.02 mg Mg/l	
Germany	Umweltbundesamt, Messtelle Schauinsland	0.01 mg Mg/l	
Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	Ca. 0.01 mg Mg/l	
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome	0.001 mg Mg/l	0.005 mg Mg/l
Latvia	Latvian Hydrometerological Agency, Riga	0.005 mg Mg/l	
Netherlands	National Institute for Public Health and Environmental Protection (RIVM), Bilthoven	0.036 mg Mg/l	
Norway	Norwegian Institute for Air Research, Kjeller	0.01 mg Mg/l	
Poland	Institute of Meteorology and Water Management, Warsaw	0.007 mg Mg/l	
	Institute of Environmental Protection, Warsaw (PL5)	0.001 mg Mg/l	
Portugal	Ministèrio do ambiente e recursos naturais, Laboratorio de Santo Andre, Santo Andre	0.03 mg Mg/l	
Russian Federation	Institute of Global Climate and Ecology, Moscow	0.001 mg Mg/l	
Slovakia	Slovak Hydrometeorological Institute, Bratislava	0.01 mg Mg/l	0.02 mg Mg/l
Spain	Instituto de Salud Carlos III	0.02 mg Mg/l	
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	0.01 mg Mg/l	0.02 mg Mg/l
Switzerland	Swiss Federal Lab. of Testing Mat. and Research Dübendorf	0.01 mg Mg/l	
United Kingdom	AEA Technology, Culham Abington	0.05 mg Mg/l	
Yugoslavia	Federal Hydrometeorological Institute, Belgrade	0.0015 mg Mg/l	

Table 3.27:

Sodium in precipitation			
Country / site	Laboratory	Laboratory lower limit	Method lower limit
Austria	Umweltbundesamt, Klagenfurt	0.01 mg Na/l	
Commission of European Com.	Joint Research Centre, Ispra Establishment		0.04 mg Na/l (from 1996)
Czech Republic	Czech Hydrometeorological Institute, Prague	0.002 mg Na/l	
Estonia	Estonian Environmental Research Centre, Tallinn	0.1 mg Na/l	
Finland	Finnish Meteorological Institute	0.002 mg Na/l	
France	l'Ecole des Mines de Douai, Laboratoire Wolff, Douai	0.02 mg Na/l	
Germany	Umweltbundesamt, Messtelle Schauinsland	0.01 mg Na/l	
Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	ca. 0.01 mg Na/l	
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome	0.001 mg Na/l	0.005 mg Na/l
Lithuania	Institute of Physics, Vilnius	0.02 mg Na/l	
Latvia	Latvian Hydrometerological Agency, Riga	0.013 mg Na/l	
Netherlands	National Institute for Public Health and Environmental Protection (RIVM), Bilthoven	0.034 mg Na/l	
Norway	Norwegian Institute for Air Research, Kjeller	0.01 mg Na/l	
Poland	Institute of Meteorology and Water Management, Warsaw	0.02 mg Na/l	
	Institute of Environmental Protection, Warsaw (PL5)	0.003 mg Na/l	
Portugal	Ministèrio do ambiente e recursos naturais, Laboratorio de Santo Andre, Santo Andre	0.025 mg Na/l,	
Russian Federation	Institute of Global Climate and Ecology, Moscow	0.01 mg Na/l	
Slovakia	Slovak Hydrometeorological Institute, Bratislava	0.01 mg Na/l	0.03 mg Na/l
Spain	Instituto de Salud Carlos III	0.10 mg Na/l	
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	0.05 mg Na/l	
Switzerland	Swiss Federal Lab. of Testing Mat. and Research Dübendorf	0.02 mg Na/l	
United Kingdom	AEA Technology, Culham Abington	0.03 mg Na/l	
Yugoslavia	Federal Hydrometeorological Institute, Belgrade	0.001 mg Na/l	

Table 3.28:

Chloride in precipitation			
Country / site	Laboratory	Laboratory lower limit	Method lower limit
Austria	Umweltbundesamt, Klagenfurt	0.034 mg Cl/l	
Commission of European Com	Joint Research Centre, Ispra Establishment		0.09 mg Cl/l (from 1996)
Czech Republic	Czech Hydrometeorological Institute, Prague	0.02 mg Cl/l	
Denmark	National Environmental Research Institute, Roskilde	0.2 mg Cl/l	
Estonia	Estonian Environmental Research Centre, Tallinn	0.1 mg Cl/l	
Finland	Finnish Meteorological Institute,	0.01 mg Cl/l	
France	l'Ecole des Mines de Douai, Laboratoire Wolff, Douai	0.05 mg Cl/l	
Germany	Umweltbundesamt, Messtelle Schauinsland	0.01 mg Cl/l	
Hungary	Institute for Atmospheric Physics, Dep. for Air Chemistry, Budapest	ca. 0.1 mg Cl/l	
Italy	C.N.R. Instituto Inquinamento Atmosferico Montelibretto, Rome	0.001 mg Cl/l	0.005 mg Cl/l
Latvia	Latvian Hydrometerological Agency, Riga	0.1 mg Cl/l	
Lithuania	Institute of Physics, Vilnius	0.01 mg Cl/l	0.29 mg Cl/l
Netherlands	National Inst. for Public Health and Env. Protection, Bilthoven	0.11 mg Cl/l	
Norway	Norwegian Institute for Air Research, Kjeller	0.01 mg Cl/l	
Poland	Institute of Meteorology and Water Management, Warsaw	0.03 mg Cl/l	
	Institute of Environmental Protection, Warsaw (PL5)	0.10 mg Cl/l	
Portugal	Ministèrio do ambiente e recursos naturais, Lab. de Santo Andre,	0.03 mg Cl/l	
Russian Federation	Institute of Global Climate and Ecology, Moscow	0.03 mg Cl/l	
Slovakia	Slovak Hydrometeorological Institute, Bratislava	0.01 mg Cl/l	
Spain	Instituto de Salud Carlos III	0.31 mg Cl/l	
Sweden	Swedish Environmental Research Institute (IVL), Gothenburg	0.05 mg Cl/l	
Switzerland	Swiss Federal Lab. of Testing Mat. and Research, Dübendorf	0.05 mg Cl/l	
United Kingdom	AEA Technology, Culham	0.05 mg Cl/l	
Yugoslavia	Federal Hydrometeorological Institute, Belgrade	0.05 mg Cl/l	

Annex 4

Calibration procedures and description of locations of the ozone measurements

Site: AT0002 Illmitz

Surrounding area:

- Vegetation (forest, grass land etc): *grass land, wine yards, lake*
- Local sources of NO_x: *narrow street (biological research station), small village in 1,5 kilometres distance*
- Local topography (valley, hill etc): *plain*

Instrumentation:

- Method: *UV absorption*
- Manufacturer and model: *HORIBA APOA 360*
- Range: *200 ppb*
- Zero instability (per week): < *0,5 ppb*
- Span instability (per week): *<1%*
- Height of intake: *3,2 m*
- Approximate distance from intake to monitor: *sampling manifold with additional pump*, sampling line from manifold to monitor: *0,5-0,8 m*
- Is the instrument in a temperature controlled room? *yes*

Maintenance:

- Frequency of general maintenance:
  - Inlet filter exchange interval: *14 days*
  - Leak test interval: *14 days*
  - Frequency of checking the pressure transducer: *14 days*
  - How often is the performance of the scrubber tested: *1/year*

- Is a logbook at site? *yes*
- Which action are followed if a drift or instability is recognised: *recalibration with transfer standard, search for reason of instability, if necessary exchange of instrument*

Calibration:

- Frequency of zero and span checks: *23 h*
- Is a transfer standard available? *yes*

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): *4/year (3 times on site, 1 in lab), 5 point calibration*
If no, how is the calibration performed and how often:

Transfer standard:

- Method: *UV absorption*
- Manufacturer and model: *Thermo Electron Instruments 49 CPS*
- Is the standard traceable to a NIST Standard Reference Photometer (SRP): #*15*
- Location of primary calibration photometer: *at EMPA, CH*
- How often is the transfer standard calibrated to a SRP: *once per year*

Data validation

Are the following data validation functions performed:

- Final data validation at site or other place: *yes (daily, monthly, yearly)*
- Consistency check(s), i.e:

  Graph plots: *yes*
  checked with instruments logbook: *yes*

Site: AT0004 St. Koloman

Surrounding area:
- Vegetation (forest, grass land etc): *meadow, forest*
- Local sources of NO_x: *farm, motorway 8 kilometres away (Salzachtal)*
- Local topography (valley, hill etc): *mountainous area*

Instrumentation:
- Method: *UV absorption*
- Manufacturer and model: *HORIBA APOA 360*
- Range: *200 ppb*
- Zero instability (per week): *<0,5 ppb*
- Span instability (per week): *<1%*
- Height of intake: *3,2 m*
- Approximate distance from intake to monitor: *sampling manifold with additional pump, sampling line from manifold to monitor: 0,5-0,8 m*
- Is the instrument in a temperature controlled room? *yes*

Maintenance:
- Frequency of general maintenance:
  - Inlet filter exchange interval: *14 days*
  - Leak test interval: *14 days*
  - Frequency of checking the pressure transducer: *14 days*
  - How often is the performance of the scrubber tested: *1/year*

- Is a logbook at site? *yes*
- Which action are followed if a drift or instability is recognised: *recalibration with transfer standard, search for reason of instability, if necessary exchange of instrument*

Calibration:
- Frequency of zero and span checks: *23 h*
- Is a transfer standard available? *yes*

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): *4/year (3 times on site, 1 in lab), 5 point calibration*
If no, how is the calibration performed and how often:

Transfer standard:
- Method: *UV absorption*
- Manufacturer and model: *Thermo Electron Instruments 49 CPS*
- Is the standard traceable to a NIST Standard Reference Photometer (SRP): *#15*
- Location of primary calibration photometer: *at EMPA, CH*
- How often is the transfer standard calibrated to a SRP: *once per year*

Data validation
Are the following data validation functions performed:
- Final data validation at site or other place: *yes (daily, monthly, yearly)*
- Consistency check(s), i.e:

  Graph plots: *yes*
  checked with instruments logbook: *yes*

Site: AT0005 Vorhegg

Surrounding area:
- Vegetation (forest, grass land etc): *meadow, forest*
- Local sources of NO_x: *narrow street, village about 3 kilometres distance*
- Local topography (valley, hill etc): *narrow valley in high alpine mountains, slope*

Instrumentation:
- Method: *UV absorption*
- Manufacturer and model: *HORIBA APOA 360*
- Range: *200 ppb*
- Zero instability (per week): *< 0,5 ppb*
- Span instability (per week): *<1%*
- Height of intake: *3,2 m*
- Approximate distance from intake to monitor: *sampling manifold with additional pump, sampling line from manifold to monitor: 0,5-0,8 m*
- Is the instrument in a temperature controlled room? *yes*

Maintenance:
- Frequency of general maintenance:
  - Inlet filter exchange interval: *14 days*
  - Leak test interval: *14 days*
  - Frequency of checking the pressure transducer: *14 days*
  - How often is the performance of the scrubber tested: *1/year*

- Is a logbook at site? *yes*
- Which action are followed if a drift or instability is recognised: recalibration with transfer standard, search for reason of instability, if necessary exchange of instrument

Calibration:
- Frequency of zero and span checks: *23 h*
- Is a transfer standard available? *yes*

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): *4/year (3 times on site, 1 in lab), 5 point calibration*
If no, how is the calibration performed and how often:

Transfer standard:
- Method: *UV absorption*
- Manufacturer and model: *Thermo Electron Instruments 49 CPS*
- Is the standard traceable to a NIST Standard Reference Photometer (SRP): *#15*
- Location of primary calibration photometer: *at EMPA, CH*
- How often is the transfer standard calibrated to a SRP: *once per year*

Data validation
Are the following data validation functions performed:
- Final data validation at site or other place: *yes (daily, monthly, yearly)*
- Consistency check(s), i.e:
  Graph plots: *yes*
  checked with instruments logbook: *yes*

Site: CH 02 Payerne

Surrounding area:
- Vegetation (forest, grass land etc): grass land, arable land
- Local sources of NO_x: little traffic
- Local topography (valley, hill etc): low hills

Instrumentation:
- Method: UV-absorption
- Manufacturer and model: ML 8810
- Range: 0-200 ppb
- Zero instability (per week): < 0.2 ppb
- Span instability (per week): < 0.2 ppb
- Height of intake: 4 m
- Approximate distance from intake to monitor: 6 m *)
  *) 5 m steel and glass tube (4 cm diameter, 10 m/s), 1 m ¼ inch teflon tube
- Is the instrument in a temperature controlled room? yes (22°C)

Maintenance:
- frequency of general maintenance:
  - Inlet filter exchange interval: 2 weeks
  - Leak test interval: no test performed
  - Frequency of checking the pressure transducer: 1 year
  - How often is the performance of the scrubber tested: 2 years

- Is a logbook at site? yes
- Which action are followed if a drift or instability is recognised:
  Calibration to transfer standard or replacement of instrument

Calibration:
- Frequency of zero and span checks: daily
- Is a transfer standard available? yes

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration):
every 3 months
If no, how is the calibration performed and how often:

Transfer standard:
- Method: UV-absorption
- Manufacturer and model: TEI 49C PS
- Is the standard traceable to a NIST Standard Reference Photometer (SRP): yes
- Location of primary calibration photometer: EMPA
- How often is the transfer standard calibrated to a SRP: every 4 months

Data validation
Are the following data validation functions performed:
- Final data validation at site or other place: yes
- Consistency check(s), i.e:
  Graph plots yes
  checked with instruments logbook yes

Site: CH 03 Tänikon

Surrounding area:
- Vegetation (forest, grass land etc): arable land
- Local sources of NO_x: little traffic
- Local topography (valley, hill etc): low hills

Instrumentation:
- Method: UV-absorption
- Manufacturer and model: ML 9810
- Range: 0-200 ppb
- Zero instability (per week): < 0.2 ppb
- Span instability (per week): < 0.2 ppb
- Height of intake: 4 m
- Approximate distance from intake to monitor: 6 m *)
  *) 5 m steel and glass tube (4 cm diameter, 10 m/s), 1 m ¼ inch teflon tube
- Is the instrument in a temperature controlled room? yes (22°C)

Maintenance:
- Frequency of general maintenance:
  - Inlet filter exchange interval: 2 weeks
  - Leak test interval: no test performed
  - Frequency of checking the pressure transducer: 3 months
  - How often is the performance of the scrubber tested: 3 months

- Is a logbook at site? yes
  Which action are followed if a drift or instability is recognised: Calibration to transfer standard or replacement of instrument

Calibration:
- Frequency of zero and span checks: daily
- Is a transfer standard available? yes

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): every 3 months
If no, how is the calibration performed and how often:

Transfer standard:
- Method: UV-absorption
- Manufacturer and model: TEI 49C PS
- Is the standard traceable to a NIST Standard Reference Photometer (SRP): yes
- Location of primary calibration photometer: EMPA
- How often is the transfer standard calibrated to a SRP: every 4 months

Data validation
Are the following data validation functions performed:
- Final data validation at site or other place: yes
- Consistency check(s), i.e:
  - Graph plots yes
  - checked with instruments logbook yes

Site: CH 04 Chaumont

Surrounding area:
- Vegetation (forest, grass land etc): grass land
- Local sources of NO_x: none
- Local topography (valley, hill etc): mountain top

Instrumentation:
- Method: UV-absorption
- Manufacturer and model: ML 8810
- Range: 0-200 ppb
- Zero instability (per week): < 0.2 ppb
- Span instability (per week): < 0.2 ppb??
- Height of intake: 4 m
- Approximate distance from intake to monitor: 6 m *)
  *) 5 m steel and glass tube (4 cm diameter, 10 m/s), 1 m ¼ inch teflon tube
- Is the instrument in a temperature controlled room? yes (22°C)

Maintenance:
- Frequency of general maintenance:
  - Inlet filter exchange interval: 2 weeks
  - Leak test interval: no test performed
  - Frequency of checking the pressure transducer: 1 year
  - How often is the performance of the scrubber tested: 2 years

- Is a logbook at site? yes
  Which action are followed if a drift or instability is recognised: Calibration to transfer standard or replacement of instrument

Calibration:
- Frequency of zero and span checks: daily
- Is a transfer standard available? yes

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): every 3 months

If no, how is the calibration performed and how often:

Transfer standard:
- Method: UV-absorption
- Manufacturer and model: TEI 49C PS
- Is the standard traceable to a NIST Standard Reference Photometer (SRP): yes
- Location of primary calibration photometer: EMPA
- How often is the transfer standard calibrated to a SRP: every 4 months

Data validation

Are the following data validation functions performed:
- Final data validation at site or other place: yes
- Consistency check(s), i.e:
  Graph plots yes
  checked with instruments logbook yes

Site: CH 05 Rigi

Surrounding area:
- Vegetation (forest, grass land etc): grass land
- Local sources of NO_x: none
- Local topography (valley, hill etc): mountain slope

Instrumentation:
- Method: UV-absorption
- Manufacturer and model: TEI 49C
- Range: 0-200 ppb
- Zero instability (per week): < 0.1 ppb
- Span instability (per week): < 0.1 ppb
- Height of intake: 4 m
- Approximate distance from intake to monitor: 6 m *)
  *) 5 m steel and glass tube (4 cm diameter, 10 m/s), 1 m ¼ inch teflon tube
- Is the instrument in a temperature controlled room? yes (22°C)

Maintenance:
- Frequency of general maintenance:
  - Inlet filter exchange interval: 2 weeks
  - Leak test interval: no test performed
  - Frequency of checking the pressure transducer: 3 months
  - How often is the performance of the scrubber tested: 2 years

- Is a logbook at site? yes
  Which action are followed if a drift or instability is recognised: Calibration to transfer standard or replacement of instrument

Calibration:
- Frequency of zero and span checks: daily
- Is a transfer standard available? yes

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): every 3 months
If no, how is the calibration performed and how often:

Transfer standard:
- Method: UV-absorption
- Manufacturer and model: TEI 49C PS
- Is the standard traceable to a NIST Standard Reference Photometer (SRP): yes
- Location of primary calibration photometer: EMPA
- How often is the transfer standard calibrated to a SRP: every 4 months

Data validation
Are the following data validation functions performed:
- Final data validation at site or other place: yes
- Consistency check(s), i.e:
  Graph plots yes
  checked with instruments logbook yes

Germany

Ozone analyzers have been checked twice in 1998 (spring and autumn) with TE49PS as transfer standards. The table gives: delta = analyzer reading in ppb minus TE49PS-setting (100 ppb). < 2 indicates, that the difference was smaler than +- 2 ppb; in that case, no correction of the instrument or the data is performed.

	spring 1998	autumn 1998
DE1 Westerland	< 2	< 2
DE2 Waldhof	+ 3	< 2
DE3 Schauinsland	< 2	- 5
DE4 Deuselbach	< 2	< 2
DE5 Brotjacklriegel	< 2	< 2
DE7 Neuglobsow	- 8	< 2
DE8 Schmücke	< 2	- 3
DE9 Zingst	< 2	< 2

The ozone values reported to the CCC have been corrected using factors calculated from the above results assuming linear drift if the difference was more than +- 2 ppb.

The TE49PS-transfer standards are checked regularly against the German ozone primary standard (UV absorption), which has been compared with the EMPA-NIST-Instrument in 1996 (agreement within ± 1 ppb). The deviation of the TE49PS transfer standards from the primary standard was never observed to be grater than ± 2 ppb, being within ± 1 ppb in most instances.

Site: DK 05 Keldsnor

Surrounding area:

Vegetation: some trees 150 meters north of the station
Local source of NO_x: none, a small city 20 km south of site
Local topography: flat, but station is 30 meters away from a cliff, which is 15 meters above sea level.

Instrumentation:

Method: UV-absorbtion in single channel instrument.
Manufacturer and model: API, either model M400 or M400A
Range: 0–500 ppb
Zero instability (per week): 1 ppb
Span instability (per week): less than 1 % of reading (not considering the dilution effect of variations in water vapor)
Height of intake: 3,6 meter above ground.
Approximate distance from intake to monitor: 3 meter
Is the instrument in a temperature controlled room: yes

Maintenance:

Frequency of general maintenance:
Inlet filter exchange interval: once a week
Leak test interval: not done in the field, only in the lab during maintenance
Frequency of checking the pressure transducer:
not done in the field, only in the lab during maintenance.
How often is the performance of the scrubber tested:
not done in the field, only in the lab during maintenance.
Is a logbook at site ?: no, but all visits are recorded.
Which action are followed if a drift or instability is recognised:
the monitor is replaced as soon as possible, that is in less than a month.

Calibration:

Frequency of zero and span checks: a check is made daily on both .
Is a transfer standard available ?: yes, in the lab, not for use at the station.
If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): not done in the field, only in the lab during maintenance.

Transfer standard:

Method: A UV-photometer
Manufacturer and model: API model 401 (photometer with build-in ozone-generator)
Is the standard traceable to a NIST Standard Reference Photometer (SRP):
yes, a NIST photometer no 11 at the University of Stockholm
Location of primary calibration photometer:
in the lab where the monitors are maintained and calibrated.
How often is the transfer standard calibrated to a SRP:
once a year.

Data validation:

Are the following data validation functions performed:
Final data validation at site or other place: In the lab.
Consistency check(s), i.e:
graph plots: yes, and comparing concentrations on several similar locations.
check with instrument logbook: yes

Site: DK31 Ulborg

Surrounding area:

Vegetation:	Uniformly 18-20 m high trees. Site in centre of 3 by 3 km forest. The intake is 36 above groundlevel.
Local source of NO_x:	none, a small town 3 km west of site
Local topography:	flat

Instrumentation:

Method:	UV-absorption in single channel instrument.
Manufacturer and model:	API, either model M400 or M400A
Range:	0-500 ppb
Zero instability (per week):	1 ppb
Span instability (per week):	less than 1 % of reading (not considering the dilution effect of variations in water vapour)
Height of intake:	18 meter above ground.
Approximate distance from intake to monitor:	23 meter
Is the instrument in a temperature controlled room:	yes

Maintenance:

Frequency of general maintenance:
Inlet filter exchange interval: once a week
Leak test interval: not done in the field, only in the lab during maintenance.
Frequency of checking the pressure transducer:
not done in the field, only in the lab during maintenance.
How often is the performance of the scrubber tested:
not done in the field, only in the lab during maintenance.
Is a logbook at site ?: no, but all visits are recorded.
Which action are followed if a drift or instability is recognised:
the monitor is replaced as soon as possible, that is in less than a month.

Calibration:

Frequency of zero and span checks: a check is made daily on both .
Is a transfer standard available ?: yes, in the lab, not for use at the station.
If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): not done in the field, only in the lab during maintenance.

Transfer standard:

Method: A UV-photometer used between stationary photometer in lab and NIST photometer in Stockholm.
Manufacturer and model: API model 401 (photometer with build-in ozone-generator)
Is the standard traceable to a NIST Standard Reference Photometer (SRP):
yes, a NIST photometer no 11 at the University of Stockholm
Location of primary calibration photometer:
in the lab where the monitors are maintained and calibrated.
How often is the transfer standard calibrated to a SRP:
once a year.

Data validation:

Are the following data validation functions performed:
Final data validation at site or other place: In the lab.
Consistency check(s), i.e:
graph plots: yes, and comparing concentrations on several similar locations.
check with instrument logbook: yes

Site: DK32 Frederiksborg

Surrounding area:

Vegetation: Uniformly 18-20 m high trees. Site at edge of 6 by 6 km forest. The intake in clearing at treetop level.
Local source of NO_x: none, a city of about 35000 inhb. 4 km south-west of site
Local topography: flat

Instrumentation:

Method: UV-absorption in single channel instrument.
Manufacturer and model: API, either model M400 or M400A
Range: 0- 500 ppb
Zero instability (per week): 1 ppb
Span instability (per week): less than 1 % of reading (not considering the dilution effect of variations in water vapour)
Height of intake: 18 meter above ground.
Approximate distance from intake to monitor: 23 meter
Is the instrument in a temperature controlled room: yes

Maintenance:

Frequency of general maintenance:
Inlet filter exchange interval: once a week
Leak test interval: not done in the field, only in the lab during maintenance.
Frequency of checking the pressure transducer: not done in the field, only in the lab during maintenance.
How often is the performance of the scrubber tested: not done in the field, only in the lab during maintenance.
Is a logbook at site ?: no, but all visits are recorded.
Which action are followed if a drift or instability is recognised: the monitor is replaced as soon as possible, that is in less than a month.

Calibration:

Frequency of zero and span checks: a check is made daily on both.
Is a transfer standard available ?: yes, in the lab, not for use at the station.
If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): not done in the field, only in the lab during maintenance.

Transfer standard:

Method: A UV-photometer used between stationary photometer in lab and NIST photometer in Stockholm.
Manufacturer and model: API model 401 (photometer with build-in ozone-generator)
Is the standard traceable to a NIST Standard Reference Photometer (SRP): yes, a NIST photometer no 11 at the University of Stockholm
Location of primary calibration photometer: in the lab where the monitors are maintained and calibrated.
How often is the transfer standard calibrated to a SRP: once a year.

Data validation:

Are the following data validation functions performed:

Final data validation at site or other place: In the lab.
Consistency check(s), i.e:
graph plots: yes, and comparing concentrations on several similar locations.
check with instrument logbook: yes

Site: EE 0011R Vilsandi

Surrounding area:
- Vegetation (forest, grass land etc): Grass land
- Local sources of NO_x: No sources of NO_x
- Local topography (valley, hill etc): Flat area

Instrumentation:
- Method: UV photometric
- Manufacturer and model: Thermo Environmental Instruments Inc. TEI 49 C
- Range: 200 ppb
- Zero instability (per week): < 2 ppb
- Span instability (per week): < 1 %
- Height of intake: 4 m
- Approximate distance from intake to monitor: 5 m
- Is the instrument in a temperature controlled room? Yes

Maintenance:
- Frequency of general maintenance:
  - Inlet filter exchange interval: 1 month
  - Leak test interval: 6 months
  - Frequency of checking the pressure transducer: 1 year
  - How often is the performance of the scrubber tested: if calibration fails

- Is a logbook at site? Yes
- Which action are followed if a drift or instability is recognised: It hasn't happened, but the analyzer would be cleaned, checked, and defective parts replaced. Small drifts have been corrected in database. (Normally drifts < 0.5 ppb per month)

Calibration:
- Frequency of zero and span checks: 1 month
- Is a transfer standard available? No

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration):
If no, how is the calibration performed and how often: With help Finnish colleagues (Finnish Meteorological Institute and Helsinki YTV) once a year. Spandrift < 2 % per year.

Transfer standard:
- Method:
- Manufacturer and model:
- Is the standard traceable to a NIST Standard Reference Photometer (SRP):
- Location of primary calibration photometer:
- How often is the transfer standard calibrated to a SRP:

Data validation
Are the following data validation functions performed:
- Final data validation at site or other place: Yes
- Consistency check(s), i.e:
  - Graph plots Yes
  - checked with instruments logbook Yes

Site: Lahemaa EE 0009R

Surrounding area:
- Vegetation (forest, grass land etc): Grass land
- Local sources of NO_x: No sources of NO_x
- Local topography (valley, hill etc): Flat area

Instrumentation:
- Method: UV photometric
- Manufacturer and model: Thermo Environmental Instruments Inc. TEI 49
- Range: 200 ppb
- Zero instability (per week): < 2 ppb
- Span instability (per week): < 1 %
- Height of intake: 4 m
- Approximate distance from intake to monitor: 5 m
- Is the instrument in a temperature controlled room? Yes

Maintenance:
- Frequency of general maintenance:
    - Inlet filter exchange interval: 1 month
    - Leak test interval: 6 months
    - Frequency of checking the pressure transducer: 1 year
    - How often is the performance of the scrubber tested: if calibration fails

- Is a logbook at site? Yes
- Which action are followed if a drift or instability is recognised: It hasn't happened, but the analyzer would be cleaned, checked, and defective parts replaced. Small drifts have been corrected in database. (Normally drifts < 0.5 ppb per month)

Calibration:
- Frequency of zero and span checks: 1 month
- Is a transfer standard available? No

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration):
If no, how is the calibration performed and how often: With help Finnish colleagues (Finnish Meteorological Institute and Helsinki YTV) once a year. Spandrift < 2 % per year.

Transfer standard:
- Method:
- Manufacturer and model:
- Is the standard traceable to a NIST Standard Reference Photometer (SRP):
- Location of primary calibration photometer:
- How often is the transfer standard calibrated to a SRP:

Data validation

Are the following data validation functions performed:
- Final data validation at site or other place: Yes
- Consistency check(s), i.e:
    - Graph plots Yes
    - checked with instruments logbook Yes

Site: Spanish stations

Instrumentation:
- Method: ULTRAVIOLET PHOTOMETER
- Manufacturer and model: MCV, S.A. Model 48 AUV (6 units in EMEP network), Model 0341 M (4 units in EMEP network).
- Range: 0-1000 ppb
- Zero instability (per week): <1 ppb
- Span instability (per week): < 1%
- Height of intake: 3.5 metres above ground
- Approximate distance from intake to monitor: 3.7 metres
- Is the instrument in a temperature controlled room? YES

Maintenance:
- Frequency of general maintenance: 15 days
  - Inlet filter exchange interval: 15 days
  - Leak test interval: 60 days
  - Frequency of checking the pressure transducer: 15 days
  - How often is the performance of the scrubber tested: 15 days

- Is a logbook at site? NO (There is a logbook which registers every event that happens, but it is at the control centre).
- Which action are followed if a drift or instability is recognised: Immediate identification of the new device that causes the problem and repair or replacement by a new one. Then, the maintenance procedure is newly applied.

Calibration:
- Frequency of zero and span checks: 15 days
- Is a transfer standard available? YES

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): Every 6 months

If no, how is the calibration performed and how often: -

Transfer standard:
- We plan to trace the transfer standard to a NIST Standard Reference Photometer, which is located at the “Instituto de Salud Carlos III” (SRP 22). The calibration of the transfer standard would be done once or twice a year.

Data validation

The following data validation operations are performed:
- Final data validation at site or other place:
  Data are received through modem in the control centre and are checked once a day at least.
- Consistency check(s), i.e:

The site operators take notes about some parameters from the automatic equipment. If something is not correct they call to the control centre.

In the control centre the communications programme informs about the correct/incorrect reception of required files. Through the validation programme every parameter is checked (ozone as well as other components) from every EMEP station (10).

All this information is analysed every day and transmitted to the technical assistance service if it is necessary to carry out any corrective or preventive action.

Automatic data are analysed with graph plots and checked with instruments logbook. Then a validation code is assigned for every single data. It is taken into account all the maintenance done in the stations: calibrations, electrical failures, perturbations. We use the meteorological data to analyse the evolution of pollutants.

Site: ES3 ROQUETES

Geographical co-ordinates:
Longitude: 0º 29’ 29’’ E
Latitude: 40º 49’ 14’’N
Altitude: 44 m.

Surrounding area:

Ground cover within a circle of 1 km (%) from station:

- Vegetation (forest, grass land etc):

Built-up area: 30%
Forest
Coniferous: 20%
Deciduous: 20%
Other
Moorland: 15%
Asphalting: 5% (Roads)

- Local sources of NO_x:

Specified sources within 200 m (burning of wood 50 m) from the sampler.

There is a rural road station 10 metres from the site. It’s an access way to The Ebro Observatory where EMEP station is located. The number of vehicles per day is no important.

The Ebro Observatory and closed buildings are provided with electrical heatings.

Another sources location

Distance (Km)	N	NE	E	SE	S	SW	W	NW
0.2 – 1			1	1	1	1		
1 – 10		2	2					
10 – 50								

1 City of Roquetes
2 City of Tortosa

The important emission sources are the cities of Roquetes (6215 inhabitants) and that of Tortosa (30000 inhabitants)

Emissions of mobile sources. (Main roads 0.2 –10 km around the station)

Road Nº	Vehicles /day	Trucks percentage
N-230	High (17704 v/d)	12%

Comments:

The station is located inside of The Ebro Observatory in the suburbs of Roquetes town. This is not a good location for an EMEP station and it’s expected to be moved very soon.

Site: ES9 CAMPISÁBALOS

Geographical co-ordinates:
Longitude: 3º 08' 34'' W
Latitude: 41º 16' 52''N
Altitude: 1360 m.

Surrounding area:

Ground cover within a circle of 1 km(%) from station:

- Vegetation (forest, grass land etc):

  Forest
  Coniferous: 80%
  Bog and heather: 5%
  Farmland
  Grass and pasture: 15%

- Local sources of NO_x:

In fact, there are no NO_x sources outside 100 km from the station.

Emissions of mobile sources. (Main roads 0.2 –10 km around the station)

Road Nº	**Vehicles /day**
C-114	Very low (<250 v/d)

The closest source of NO_x is the rural Road (C-114) linking this site with Campisábalos (50 inhabitants).

Comments:

Recently, a complete reforestation plan of pine tree wood and oak has been carried out in the whole surrounding area.

Site: ES10 CABO DE CREUS

Geographical co-ordinates:
Longitude: 3º 19' 01'' E
Latitude: 42º 19' 10''N
Altitude: 23 m.

Surrounding area:

Ground cover within a circle of 1 km(%) from station:

- Vegetation (forest, grass land etc):

Built-up area: <1%
Forest
Shrub: 19%
Water surface: 63%
Other
Unproductive soil: 17%
Asphalted: <1%

- Local sources of NO_x:

The station is located inside the building of Cabo de Creus Lighthouse.

Emissions of mobile sources. (Main roads 0.2 – 10 km around the station)

Road Nº	**Vehicles /day**
Road Roses-Cadaqués	>250 v/d low <10.000 v/d (traffic increases in summer season, among June and September)
Access Road to the Lighthouse	Very low (<250 v/d)

The EMEP station is near to Mediterranean sea. The surroundings of the station are the coastal area.

Cadaqués village has 1909 inhabitants

Site: ES7 VÍZNAR

Geographical co-ordinates:

Longitude: 3º 28' 28'' W
Latitude: 37º 14' 18''N
Altitude: 1230 m.

Surrounding area:

Ground cover within a circle of 1 km (%) from station:

- Vegetation (forest, grass land etc):

Built-up area: <1%
Forest
Coniferous: 17%
Shrub: 37%
Farmland
Crops: 42%
Other
Asphalted: 3%

- Local sources of NO_x:

Distance (Km)	**N**	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**
0.2 – 1								
1 – 10						1		
10 – 50								

1 Granada city

The important emission source is Granada city (272.738 inhabitants).

Comments:

Although there are zones open as cultive soil, they are not in use because of the declaration of National Park.

Site: ES1 SAN PABLO DE LOS MONTES

Geographical co-ordinates:

Longitude: 4º 20' 55'' W
Latitude: 39º 32' 52''N
Altitude: 917 m.

Surrounding area:

Ground cover within a circle of 1 km (%) from station:

- Vegetation (forest, grass land etc):

Built-up area: 4%
Forest
Deciduous: 20%
Farmland
Crops: 10%
Other
Moorland: 65%
Asphalted: 1%

- Local sources of NO_x:

The closest source of NO_x, 225 m, is the rural Road linking Las Navillas village with San Pablo de los Montes (C-403). The number of vehicles per day is very low (<50 v/d).

Distance (Km)	N	NE	E	SE	S	SW	W	NW
0.2 – 1			2					
1 – 10								
10 – 50		1						

1 Thermo Power Station
2 San Pablo de los Montes town (2300 inhabitants).

Specification of important point sources.

Source type	Distance (km)	Emissions (NO_x)
Thermo Power Aceca	85	298 (tones/year)

The Aceca Thermo Power Station have 2 fuel-gas generator groups.

Site: **ES4** **LOGROÑO**

Geographical co-ordinates:

Longitude: 2º 30’ 11’’ W
Latitude: 42º 27’ 28’’N
Altitude: 445 m.

Surrounding area:

Ground cover within a circle of 1 km (%) from station:

- Vegetation (forest, grass land etc):

Built-up area: 2%
Forest
  coniferous: 20%
Farmland
  Crops: 72%
Water surface: 2%
Other
  Moorland: 3%
  Asphalted: 1%

- Local sources of NO_x:

The closest source of NO_x, 400 m, is the national Road N-232. (Percentage of vehicles: 81% cars run on diesel and for cars run on diesel, 19% for trucks on diesel).

Logroño city is an important emission source very near to EMEP station.

Distance (Km)	**N**	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**
0.2 – 1								
1 – 10			1					
10 – 50								

1 Logroño city (121.910 inhabitants)

Emissions of mobile sources. (Main roads 0.2 –10 km around the station)

Road Nº	**Vehicles /day**
A-68	Medium (4493 v/d)
N-232	High (17185 v/d)
N-111	*
N-120	*

* There are no data available on these roads.

Comments:

The station is really influenced by road traffic. This is not a good location for an EMEP station and it’s expected to be moved very soon.

Site: ES8 NIEMBRO

Geographical co-ordinates:

Longitude: 4º 51’ 01’’ W
Latitude: 43º 26’ 32’’N
Altitude: 134 m.

Surrounding area:

Ground cover within a circle of 1 km (%) from station:

- Vegetation (forest, grass land etc):

  Built-up area: <1%
  Forest
  shrub: 12%
  Farmland
  Grass and pasture: 29%
  Crops: 8%
  Water surface: 52%
  Other
  Unproductive soil: <1%
  Asphalted: <1%

- Local sources of NO_x:

The closest source of NO_x is the access road to the Telecommunication Station of Telefonica, S.A. It is only used by technical service personnel. The distance from the road to the EMEP station are 160 m.

The closest cities to the stations are specified in the next table:

Name	Inhabitants	Distance (km)
Niembro	625	1
La Nueva	3.940	7
Llanes	14.716	8
Ribadesella	6.472	17

Emissions from sources outside the site:

Distance (Km)	N	NE	E	SE	S	SW	W	NW
0.2 – 1								
1 – 10								
10 – 50					1	2	3	

1 Power station of Velilla
2 Power station of la Robla. Unión Fenosa.
3 Ensidesa Gijón
Fertilizante Enfersa
Ensidesa Avilés
Power Station of Soto de Ribera
Power Station of Lada. Cia. Eléctrica de Langreo
Power Station of Aboño. Hidroeléctrica Cantábrico

Source type	**Distance (km)**	**Emissions NO_x estimate (tones/year)**
Ensidesa Gijón	67	4815
Power station of Velilla	68.5	9355
Power Station of Lada	70	5624
Fertilizante Enfersa	70.5	1543
Power Station of Aboño	78.5	16518
Power Station of Soto de Ribera	84.5	11089
Ensidesa Avilés	87.5	6187
Power station of la Robla	96.5	16025

Emissions of mobile sources. (Main roads 0.2 –10 km around the station)

Road Nº	**Vehicles /day**
C-634*	Low (250-2000 v/d)

* this road connects Gijón and Santander cities.

Comments:

The station is placed close to the Telecommunication Station of Telefonica, S.A. It has an auxiliar power system of gas-oil. It only turns on at flow power cut off, it happen only few times a year. The emissions estimated from this system are negligible.

Site: ES5 NOIA

Geographical co-ordinates:

Longitude: 8º 55’ 25’’ W
Latitude: 42º 43’ 41’’N
Altitude: 683 m.

Surrounding area:

Ground cover within a circle of 1 km(%) from station:

- Vegetation (forest, grass land etc):

  Built-up area: 5%
  Forest
  coniferous: 15%
  deciduous: 15%
  Water surface: 1%
  Other
  Bush vegetation: 62%
  Asphalted: 2%

- Local sources of NO_x:

The station is placed inside a military base. There are movements of military trucks every day.

The closest cities to the stations are specified in the next table:

Name	Inhabitants	Distance (km)
Santiago de Compostela	111.450	35
La Coruña	252.450	80
Vigo	288.570	39
Villagarcía de Arosa	33.680	19
Muros	11.520	13

Emissions of mobile sources. (Main roads 0.2 –10 km around the station)

Road Nº	Vehicles /day
C-550	Low (250-2000 v/d)

Comments:

The station is located inside a military base. It’s planned to move this station very soon.

Site: ES11 BARCARROTA

Geographical co-ordinates:

Longitude: 6º 55’ 22’’ W
Latitude: 38º 28’ 33’’N
Altitude: 393 m.

Surrounding area:

Ground cover within a circle of 1 km(%) from station:

- Vegetation (forest, grass land etc):

  Built-up area: <1%
  Forest
  deciduous: 76%
  Water surface: 21%
  Other
  Unproductive soil: <1%
  Asphalted: 1%

- Local sources of NO_x:

The closest cities to the stations are specified in the next table:

Name	Inhabitants	Distance (km)
Barcarrota	2.000	10
Olivenza	4.593	21
Jerez de los Caballeros	7867	22.5
Badajoz	23.940	28
Mérida	14.716	45.5
Zafra	59.408	45.5
Evora	6.472	91
Cáceres	22.625	94.5

Distance (Km)	N	NE	E	SE	S	SW	W	NW
0.2 – 1								
1 – 10								
10 – 50				1				

1 Siderurgy Balboa, S.A. (Jerez de los Caballeros). Manufacturation of steel.

Source type	Distance (km)	Emissions NO_x estimate (tones/year)
Siderurgy Balboa, S.A.	22	60000

Comments:
The station is near to the Reservoir of Ahijón.

Site: ES12 ZARRA

Geographical co-ordinates:
Longitude: 1º 06' 07'' W
Latitude: 39º 05' 10''N
Altitude: 885 m.

Surrounding area:
Ground cover within a circle of 1 km(%) from station:

- Vegetation (forest, grass land etc):
  Built-up area: <1%
  Forest coniferous: 5% and shrub: 65%
  Water surface: <1%
  Other: Unproductive soil: 28%

- Local sources of NO_x:

The closest source of NO_x, 225 m, is access way to the the rural Road, only used by technical service for manteinance telefónica's communication center and a TV Repeater station. The closest cities to the stations are specified in the next table:

Name	**Inhabitants**	**Distance (km)**
Zarra	457	2
Ayora	5.594	4.5
Almansa	23.473	20.2
Requena	18.83	44
Albacete	143.779	65
Valencia	73.299	76
Xativa	25.992	51
Jarafuel	1.031	6
Alicante	276.526	101

Distance (Km)	**N**	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**
0.2 – 1								
1 – 10								
10 – 50		1						
50-100		2,4		3				

1 Compañía Valenciana C.P.S.A. (Buñol, Valencia)
2 Cementos ASLAND S.A. (Burjasot, Valencia)
3 Compañía Valenciana C.P.S.A. (San Vicente del Raspeig, Alicante)
4 Factoría FORD España. (Almufasses. València)

Emissions of mobile sources. (Main roads 0.2 –10 km around the station)

Road Nº	**Vehicles /day**
C-322[1]	Low (250-2000 v/d)
C-330[2]	Low (250-2000 v/d)

[1] regional road. Links the villages of Ayora and Carcelén.
[2] regional road. Links the villages of Ayora and Requena.

Comments:

The analysers are located over the lower slope of Mount Cerro Gordo. In addition to this there are a telefónica's communication center and a TV Repeater station.

Site: FI37 Ähtäri

Surrounding area:

- Vegetation (forest, grass land etc):
  Within a circle of 1 km
  - 50% coniferous forest
  - 20% bog and heather
  - 20% water surface
  - 5% grass and pasture
  - 4% grassland (not grazed by domestic animals)
  - 1% built-up area
- Local sources of NO_x: the area of Ähtäri, distance from station 6 km
- Local topography (valley, hill etc):
  - Gently rolling
  - Lot of lakes and ponds

Instrumentation:

- Method: UV-photometric
- Manufacturer and model: Thermo Environmental Instruments, TEI 49 C
- Range: 500 ppb
- Zero instability (per week): < 2 ppb
- Span instability (per week): < 1 %
- Height of intake: 5 m
- Approximate distance from intake to monitor: 4 m
- Is the instrument in a temperature controlled room? yes

Maintenance:

- Frequency of general maintenance: 3 months
  - Inlet filter exchange interval: 3 months
  - Leak test interval: 3 months
  - Frequency of checking the pressure transducer: 3 months
  - How often is the performance of the scrubber tested: every 3 months

- Is a logbook at site? yes
- Which action are followed if a drift or instability is recognised: maintenance and calibration

Calibration:

- Frequency of zero and span checks: 3 months
- Is a transfer standard available? yes

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): every 3 months
If no, how is the calibration performed and how often:

Transfer standard:

- Method: UV-photometric
- Manufacturer and model: Thermo Environmental Instruments, TEI 49 CPS
- Is the standard traceable to a NIST Standard Reference Photometer (SRP): yes
- Location of primary calibration photometer: FMI laboratory, Helsinki, Finland
- How often is the transfer standard calibrated to a SRP: at least once a year

Data validation

Are the following data validation functions performed:

- Final data validation at site or other place: yes
- Consistency check(s), i.e:
  Graph plots: yes
  checked with instruments logbook: yes

Site: FI22 Oulanka

Surrounding area:

- Vegetation (forest, grass land etc):
  Within a circle of 1 km
  - 70% coniferous forest
  - 25% bog and heather
  - 5% water surface

- Local sources of NO_x:
  - the area of Kuusamo, distance from station 0-100km
  - road 8693
- Local topography (valley, hill etc): Gently rolling

Instrumentation:

- Method: UV-photometric
- Manufacturer and model: Dasibi Environmental corp., DAS 1008 AH
- Range: 1000 ppb
- Zero instability (per week): < 1 ppb
- Span instability (per week): < 1 %
- Height of intake: 5 m
- Approximate distance from intake to monitor: 4 m
- Is the instrument in a temperature controlled room? yes

Maintenance:

- Frequency of general maintenance: 3 months
  - Inlet filter exchange interval: 3 months
  - Leak test interval: 3 months
  - Frequency of checking the pressure transducer: 3 months
  - How often is the performance of the scrubber tested: every 3 months

- Is a logbook at site? yes
- Which action are followed if a drift or instability is recognised: maintenance and calibration

Calibration:

- Frequency of zero and span checks: 3 months
- Is a transfer standard available? yes

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): every 3 months
If no, how is the calibration performed and how often:

Transfer standard:

- Method: UV-photometric
- Manufacturer and model: Thermo Environmental Instruments, TEI 49 CPS
- Is the standard traceable to a NIST Standard Reference Photometer (SRP): yes
- Location of primary calibration photometer: FMI laboratory, Helsinki, Finland
- How often is the transfer standard calibrated to a SRP: at least once a year

Data validation

Are the following data validation functions performed:

- Final data validation at site or other place: yes
- Consistency check(s), i.e:
  Graph plots: yes
  checked with instruments logbook: yes

Site: FI09 Utö

Surrounding area:
- Vegetation (forest, grass land etc): a treeless island (roughly 1 km x 1 km)
- Local sources of NO_x:
  - An electricity supply generator at a distance of 800 m
  - A small village and harbour 400 m north of the site
    - Recreation boats during the holiday season
    - The small ferry occasionally
- Local topography (valley, hill etc): rocky island and sea

Instrumentation:
- Method: UV-photometric
- Manufacturer and model: Dasibi Environmental corp., DAS 1008 PC
- Range: 1000 ppb
- Zero instability (per week): < 1 ppb
- Span instability (per week): < 1 %
- Height of intake: 5 m
- Approximate distance from intake to monitor: 4 m
- Is the instrument in a temperature controlled room? yes

Maintenance:
- Frequency of general maintenance: 3 months
  - Inlet filter exchange interval: 3 months
  - Leak test interval: 3 months
  - Frequency of checking the pressure transducer: 3 months
  - How often is the performance of the scrubber tested: every 3 months

- Is a logbook at site? yes
- Which action are followed if a drift or instability is recognised: maintenance and calibration

Calibration:
- Frequency of zero and span checks: 3 months
- Is a transfer standard available? yes

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): every 3 months
If no, how is the calibration performed and how often:

Transfer standard:
- Method: UV-photometric
- Manufacturer and model: Thermo Environmental Instruments, TEI 49 CPS
- Is the standard traceable to a NIST Standard Reference Photometer (SRP): yes
- Location of primary calibration photometer: FMI laboratory, Helsinki, Finland
- How often is the transfer standard calibrated to a SRP: at least once a year

Data validation
Are the following data validation functions performed:
- Final data validation at site or other place: yes
- Consistency check(s), i.e:

  Graph plots: yes
  checked with instruments logbook: yes

Site: FI17 Virolahti

Surrounding area:

- Vegetation (forest, grass land etc):
  Within a circle of 1 km
  - 50% coniferous forest
  - 40% grassland (not grazed by domestic animals)
  - 9 % grass and pasture
  - 1 % built-up area
- Local sources of NO_x:
  - The area of Virolahti, distance from station 0-20 km
  - roads E3, 7, 351 and 3511
- Local topography (valley, hill etc): low seaside area

Instrumentation:

- Method: UV-photometric
- Manufacturer and model: Environnement SA, Env. O3 41 M
- Range: 1000 ppb
- Zero instability (per week): < 1 ppb
- Span instability (per week): < 1 %
- Height of intake: 5 m
- Approximate distance from intake to monitor: 4 m
- Is the instrument in a temperature controlled room? yes

Maintenance:

- Frequency of general maintenance: 3 months
  - Inlet filter exchange interval: 3 months
  - Leak test interval: 3 months
  - Frequency of checking the pressure transducer: 3 months
  - How often is the performance of the scrubber tested: every 3 months

- Is a logbook at site? yes
- Which action are followed if a drift or instability is recognised: maintenance and calibration

Calibration:

- Frequency of zero and span checks: 3 months
- Is a transfer standard available? yes

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): every 3 months
If no, how is the calibration performed and how often:

Transfer standard:

- Method: UV-photometric
- Manufacturer and model: Thermo Environmental Instruments, TEI 49 CPS
- Is the standard traceable to a NIST Standard Reference Photometer (SRP): yes
- Location of primary calibration photometer: FMI laboratory, Helsinki, Finland
- How often is the transfer standard calibrated to a SRP: at least once a year

Data validation

Are the following data validation functions performed:

- Final data validation at site or other place: yes
- Consistency check(s), i.e:
  Graph plots: yes
  checked with instruments logbook: yes

Site: FR08 DONON 1998

Surrounding area:

Vegetation (forest, grass land etc):	Forest
Local sources of NO_x:	None
Local topography (valley, hill etc):	low hill

Instrumentation:

- Method: UV Absorption
- Manufacturer and model: Environnement SA, O341M
- Range: 0-1000 ppb
- Zero instability (per week): < 1 ppb
- Span instability (per week): < 1 %
- Height of intake: 7 m; 16 m; 30 m; 44 m
- Approximate distance from intake to monitor: 60 m
- Is the instrument in a temperature controlled room? yes

Maintenance:

- Frequency of general maintenance: fortnightly
  - Inlet filter exchange interval: monthly
  - Leak test interval: fortnightly
  - Frequency of checking the pressure transducer: none
  - How often is the performance of the scrubber tested: replaced every six months

- Is a logbook at site? yes
- Which action are followed if a drift or instability is recognised: checked with transfer standard , no data validation for the period.

Calibration:

- Frequency of zero and span checks: fortnightly
- Is a transfer standard available? yes

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): three months (monopoint calibration)

If no, how is the calibration performed and how often:

Transfer standard:

- Method: Ozone generator
- Manufacturer and model: LNI Industries: SONIMIX 3001A
- Is the standard traceable to a UMEG (up to February 2000 ; to a NIST from February 2000)
- Location of primary calibration photometer: LNE (Laboratoire National d'Essais) PARIS
- How often is the transfer standard calibrated to a SRP: three months

Data validation

Are the following data validation functions performed:

- Final data validation at site or other place: At Central Laboratory ASPA Strasbourg
- Consistency check(s), i.e:
  - Graph plots: Yes
  - checked with instruments logbook: Yes

Site: FR14 MONTANDON 1998

Surrounding area:

Vegetation (forest, grass land etc):	Forest (300m), grazing
Local sources of NO_x:	None
Local topography (valley, hill etc):	Plateau (750m) along valley

Instrumentation:

- Method: UV Absorption
- Manufacturer and model: Environnement SA, O341M
- Range: 0-1000 ppb
- Zero instability (per week): < 1 ppb
- Span instability (per week): < 1 %
- Height of intake: 2,5 m
- Approximate distance from intake to monitor: 5 m
- Is the instrument in a temperature controlled room? yes

Maintenance:

- Frequency of general maintenance: 15 days
  - Inlet filter exchange interval: monthly
  - Leak test interval: yearly
  - Frequency of checking the pressure transducer: 15 days
  - How often is the performance of the scrubber tested:
- Is a logbook at site? yes
- Which action are followed if a drift or instability is recognised: Checkedwith transfer standard , no data validation for the period.

Calibration:

- Frequency of zero and span checks: 3 days
- Is a transfer standard available? yes

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): three months (monopoint calibration)

If no, how is the calibration performed and how often:

Transfer standard:

- Method: Ozone generator
- Manufacturer and model: LNI Industries: SONIMIX 3001A
- Is the standard traceable to a UMEG (up to February 2000; to a NIST from February 2000)
- Location of primary calibration photometer: LNE (Laboratoire National d'Essais) PARIS
- How often is the transfer standard calibrated to a SRP: three months

Data validation

Are the following data validation functions performed:

- Final data validation at site or other place: At Central Laboratory
- Consistency check(s), i.e:
  - Graph plots Yes
  - checked with instruments logbook Yes

Site: FR10 MORVAN 1998

Surrounding area:

Vegetation (forest, grass land etc):	Forest (300m)
Local sources of NO_x:	None
Local topography (valley, hill etc):	Plateau

Instrumentation:

- Method: UV Absorption
- Manufacturer and model: SERES, OZ2000
- Range: 0-500 ppb
- Zero instability (per week): < 2 ppb
- Span instability (per week): < 2 %
- Height of intake: 3 m
- Approximate distance from intake to monitor: 5 m
- Is the instrument in a temperature controlled room? yes

Maintenance:

- Frequency of general maintenance: monthly
  - Inlet filter exchange interval: monthly
  - Leak test interval: monthly
  - Frequency of checking the pressure transducer: monthly
  - How often is the performance of the scrubber tested: replaced every six months

- Is a logbook at site? yes
- Which action are followed if a drift or instability is recognised: Checked with transfer standard , no data validation for the period.

Calibration:

- Frequency of zero and span checks: weekly
- Is a transfer standard available? yes
- If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): six months (monopoint calibration)

If no, how is the calibration performed and how often:

Transfer standard:

- Method: Ozone generator
- Manufacturer and model: TEI: 165 model
- Is the standard traceable to a UMEG (up to February 2000; to a NIST from February 2000)
- Location of primary calibration photometer: LNE (Laboratoire National d'Essais) PARIS
- How often is the transfer standard calibrated to a SRP: three months

Data validation

Are the following data validation functions performed:

- Final data validation at site or other place: At Central Laboratory: ATMOSF"AIR BOURGOGNE (Dijon)
- Consistency check(s), i.e:
  - Graph plots Yes
  - checked with instruments logbook Yes

Site: FR13 PEYRUSSE VIEILLE 1998

Surrounding area:

Vegetation (forest, grass land etc): grass land
Local sources of NO_x: None
Local topography (valley, hill etc): hill

Instrumentation:

- Method: UV Absorption
- Manufacturer and model: ENVIRONNEMENT SA , O341M
- Range: 0-1000 ppb
- Zero instability (per week): < 1 ppb
- Span instability (per week): < 1 %
- Height of intake: 4 m
- Approximate distance from intake to monitor: 6 m
- Is the instrument in a temperature controlled room? yes

Maintenance:

- Frequency of general maintenance:
  - Inlet filter exchange interval: 15 days
  - Leak test interval: six months
  - Frequency of checking the pressure transducer: 15 days
  - How often is the performance of the scrubber tested: replaced every six months

- Is a logbook at site? yes
- Which action are followed if a drift or instability is recognised: Checked with transfer standard, no data validation for the period.

Calibration:

- Frequency of zero and span checks: 15 days
- Is a transfer standard available? yes

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): six months (monopoint calibration)

If no, how is the calibration performed and how often:

Transfer standard:

- Method: Ozone generator
- Manufacturer and model: LNI INdustries: sonimix 3001 + TEI Model 165
- Is the standard traceable to a UMEG (up to February 2000; to a NIST from February 2000)
- Location of primary calibration photometer: LNE (Laboratoire National d'Essais) PARIS
- How often is the transfer standard calibrated to a SRP: three months

Data validation

Are the following data validation functions performed:

- Final data validation at site or other place: At Central Laboratory: ORAMIP (Colomiers)
- Consistency check(s), i.e:

  Graph plots Yes
  checked with instruments logbook Yes

Site: FR 09 REVIN 1998

Surrounding area:

Vegetation (forest, grass land etc): Forest
Local sources of NO_x: None
Local topography (valley, hill etc): top of valley

Instrumentation:

- Method: UV Absorption
- Manufacturer and model: SERES, OZ2000
- Range: 0-500 ppb
- Zero instability (per week): < 2 ppb
- Span instability (per week): < 2 %
- Height of intake: 2,5 m
- Approximate distance from intake to monitor: 3 m
- Is the instrument in a temperature controlled room? yes

Maintenance:

- Frequency of general maintenance: weekly
    - Inlet filter exchange interval: 15 days
    - Leak test interval: weekly
    - Frequency of checking the pressure transducer: monthly
    - How often is the performance of the scrubber tested: replaced every six months

- Is a logbook at site? yes
- Which action are followed if a drift or instability is recognised: Checked with transfer standard , no data validation for the period.

Calibration:

- Frequency of zero and span checks: weekly
- Is a transfer standard available? yes
- If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): two months (monopoint calibration)

If no, how is the calibration performed and how often:

Transfer standard:

- Method: Ozone generator
- Manufacturer and model: LNI INdustries: sonimix 3001
- Is the standard traceable to a UMEG (up to February 2000; to a NIST from February 2000)
- Location of primary calibration photometer: LNE (Laboratoire National d'Essais) PARIS
- How often is the transfer standard calibrated to a SRP: three months

Data validation

Are the following data validation functions performed:

- Final data validation at site or other place: At Central Laboratory: ARSQA (Reims)
- Consistency check(s), i.e:

  Graph plots Yes
  checked with instruments logbook Yes

Site: All UK stations

Instrumentation:

- Method: UV absorption
- Manufacturer and model: mainly ML8810
- Range: 500 ppb
- Zero instability (per week): 2 ppb max
- Span instability (per week): 1% / month max
- Height of intake:
- Approximate distance from intake to monitor:
- Is the instrument in a temperature controlled room?

Maintenance:

- Frequency of general maintenance: 6 months
  - Inlet filter exchange interval: 1 month
  - Leak test interval: 3 months
  - Frequency of checking the pressure transducer: checked as part of photometric calibration (3 months)
  - How often is the performance of the scrubber tested: checked as part of photometric calibration (3 months)
  -

- Is a logbook at site? Records are kept of all site activities
- Which action are followed if a drift or instability is recognised: Drifts or instabilities are corrected for in data "ratification" i.e retrospective application of calibration data and general data checking

Calibration:

- Frequency of zero and span checks: daily autocalibrations
- Is a transfer standard available? yes

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): 3 months
If no, how is the calibration performed and how often:

Transfer standard:

- Method: UV absorption
- Manufacturer and model: API 401
- Is the standard traceable to a NIST Standard Reference Photometer (SRP):yes
- Location of primary calibration photometer: National Physical Laboratory, UK.
- How often is the transfer standard calibrated to a SRP: 3 months

Data validation

Are the following data validation functions performed:

- Final data validation at site or other place: yes
- Consistency check(s), i.e:

  Graph plots yes
- checked with instruments logbook yes

UK sites

Site Name	Manufacturer	Model	Range ppb	Height intake	Distance intake	Local Topography	Vegetation
GB31 Aston Hill	Monitor Labs	ML8810	500	3	>4	Open rural landscape	Fields wth nearest trees 50m away
GB32 Bottersford	TECO	TE49	200	5	>4	Open landscape	Farmland
GB33 Bush	Monitor Labs	ML8810	500	8	>4	Open landscape	Grassland. Nearest trees 40m away
GB02 Eskdalemuir	Monitor Labs	ML8810	500	3	>4	Open landscape	Grass
GB34 Glazebury	Monitor Labs	ML8810	500	3	>4	Open remote landscape	Grassland.
GB35Great Dun Fell	Monitor Labs	ML8810	500	2	40	Open rural landscape	Farmland. Nearest trees 5m away
GB36 Harwell	Monitor Labs	ML8810	500	3	>4	Open landscape	Agucultural fields. Nearest trees 200-300m away
GB14 High Muffels	Monitor Labs	ML8810	500	3	>4	Open Remote landscape	Forest plantation
GB06 Lough Navar	Monitor Labs	ML8810	500	2.5	>4	Open rural landscape	Semi mature forrest. Woodland 25m away
GB38 Lullington Heath	Monitor Labs	ML8810	500	3	>4	Open rural landscape	Heathland
GB43 Narbeth	ambirack	ambirack	500	3	>4	Open rural landscape	Field Edge, Adjacent to hedgerow. Light industry 0.5-1.8k away
GB39 Sibton	Monitor Labs	ML8810	500	3	>4	Open rural landscape	Fields, trees, woodland and hedgerows
GB44 Somerton	API	API400	500	3	>4	Open rural landscape	Fields
GB15 Strath Vaich	Monitor Labs	ML8810	500	3	>4	Open Remote landscape	Moorlands
GB45 Wicken Fenn	Monitor Labs	ML8810	500	2.5	>4	Open rural landscape	Fields with isolated trees
GB13 Yarner Wood	Monitor Labs	ML8810	500	5	>4	Open rural landscape	Heathland

Site: HU0002R K-puszta, Hungary

Surrounding area:

- Vegetation (forest, grass land etc): *clearing in a mixed forest (dominantly Scotch fir)*
- Local sources of NO_x: *no*
- Local topography (valley, hill etc): *flat (Hungarian Great Plain)*

Instrumentation:

- Method: *UV absorption*
- Manufacturer and model: *Thermo Environmental Model 49*
- Range: *0-1000 ppb*
- Zero instability (per week): *less than 1 ppb (manufacturer specification)*
- Span instability (per week): *less than 2 ppb (manufacturer specification)*
  experiment shows very low instrument instability (less than 1%/year)
- Height of intake: *10 m*
- Approximate distance from intake to monitor: *12 m*
- Is the instrument in a temperature controlled room? *Yes*

Maintenance:

- Frequency of general maintenance:
  - Inlet filter exchange interval: *weekly*
  - Leak test interval: *weekly*
  - Frequency of checking the pressure transducer: *not tested*
  - How often is the performance of the scrubber tested: *not tested*

- Is a logbook at site? *Yes*
- Which action are followed if a drift or instability is recognised: *recalibration or change of instrument; correction or rejection of the data*

Calibration:

- Frequency of zero and span checks: *6 months, or before and after maintenance*
- Is a transfer standard available? *Yes*

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): *6 months, or before and after maintenance*

If no, how is the calibration performed and how often:

Transfer standard:

- Method: *UV absorption*
- Manufacturer and model: *Thermo Environmental Model 49PS*
- Is the standard traceable to a NIST Standard Reference Photometer (SRP): *yes (SRP-17)*
- Location of primary calibration photometer: *Czech Hydrometeorological Inst., Prague, Czech Republic*
- How often is the transfer standard calibrated to a SRP: *annually*

Data validation

Are the following data validation functions performed:

- Final data validation at site or other place: *yes*
- Consistency check(s), i.e:
  Graph plots: *yes*
  checked with instruments logbook: *yes*

Site: IT01 Montelibretti

Surrounding area:

- Vegetation: Grass land
- Local sources of NOx: The station is inside the Research Area of Rome of C.N.R.; the nearest road is a small private road, about 50 m far from the sampling station
- Local topography: On a small hill

Instrumentation:

- Method: UV absorption
- Manufacturer and model: API (Advanced Pollution Instrumentation Inc.) MODEL 400
- Range: 0 - 500 ppb (maximum possible range: 10 ppm)
- Zero instability (per week): 0.4 ppb
- Span instability (per week) 0.4 % of reading
- Height of intake: About 2 meters
- Approximate distance from intake to monitor: 1.5 meters
- Is the instrument in a temperature controlled room? Yes

Maintenance:

- Frequency of general maintenance:
  - Inlet filter exchange interval: 15 days
  - Leak test interval: Not performed as a routine maintenance procedure: a warning message is displayed by the instrument in case of leaks
  - Frequency of checking the pressure transducer: Not performed as a routine maintenance procedure: a warning message is displayed by the instrument in case of pressure transducer failures
  - How often is the performance of the scrubber tested:
    Not performed as a routine maintenance procedure
- Is a logbook at site? Yes
- Which action are followed if a drift or instability is recognised:
  The cell is cleaned, the sintered filters are replaced

Calibration:

- Frequency of zero and span checks:
  Every two weeks
- Is a transfer standard available?
  The transfer standard is available but the calibration is directly performed with a primary calibration photometer
- How is the calibration performed and how often:
  Calibration is performed at the Institute of Atmospheric Pollution (500 m from the EMEP station) every three months with a primary calibration photometer (Environics model 300). A second UV analyser – also calibrated with a primary calibration photometer - is placed in the EMEP station during the calibration procedure of the first analyser.

Transfer standard:

- Method: UV absorption
- Manufacturer and model: API (Advanced Pollution Instrumentation Inc.) MODEL 400
- Is the standard traceable to a NIST Standard Reference Photometer (SRP): Yes
- Location of primary calibration photometer:
  Institute of Atmospheric Pollution (500 m from the EMEP station)
- How often is the transfer standard calibrated to a SRP: Every three months

Data validation

Are the following data validation functions performed:

- Final data validation at site or other place: At the Institute of Atmospheric Pollution
- Consistency check(s):
  Graph plots: identification of excessive noise; detection of trace below the zero baseline.
  Check of instrument logbook Cross check with the temporal trend of natural radioactivity.

Site: LV 10 Rucava

Surrounding area:
- Vegetation (forest, grass land etc): farmland and small groups of trees
- Local sources of NO_x: no
- Local topography (valley, hill etc): plain

Instrumentation:
- Method: UV photometer
- Manufacturer and model: "Environment ", France, ozone analyzer O_3 41M
- Range: 0-500 ppb
- Zero instability (per week): --
- Span instability (per week): --
- Height of intake: 3 m
- Approximate distance from intake to monitor: 8 m
- Is the instrument in a temperature controlled room? yes, every day

Maintenance:
- Frequency of general maintenance: yearly
  - Inlet filter exchange interval: 1 time in 4 months
  - Leak test interval: 2 times per month
  - Frequency of checking the pressure transducer: --
  - How often is the performance of the scrubber tested: --

- Is a logbook at site? yes
- Which action are followed if a drift or instability is recognised: an expert

Calibration:
- Frequency of zero and span checks: automatically, every day
- Is a transfer standard available? no

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration):
If no, how is the calibration performed and how often: perform at the Air Pollution Laboratory, Institute of Applied Environmental Research Stockholm University, yearly, NIST Standard Reference Photometer

Transfer standard:
- Method:
- Manufacturer and model:
- Is the standard traceable to a NIST Standard Reference Photometer (SRP):
- Location of primary calibration photometer:
- How often is the transfer standard calibrated to a SRP:

Data validation
Are the following data validation functions performed:
- Final data validation at site or other place: Environmental Quality Observation Department,
- Consistency check(s), i.e: every month
  Graph plots: yes
  checked with instruments logbook: yes

Site: All Norwegian stations

Instrumentation:
- Method: *UV*
- Manufacturer and model: *API 400*
- Range: *0-250 ppb*
- Zero instability (per week): ±*1 ppb*
- Span instability (per week):
- Height of intake: *ca 2 m*
- Approximate distance from intake to monitor: *ca 3m*
- Is the instrument in a temperature controlled room? *yes*

Maintenance:
- Frequency of general maintenance: *every 3rd month*
    - Inlet filter exchange interval: *every 3rd month*
    - Leak test interval: *every 3rd month*
    - Frequency of checking the pressure transducer: *yearly*
    - How often is the performance of the scrubber tested: *yearly*

- Is a logbook at site? *no at NILU*
- Which action are followed if a drift or instability is recognised: *change monitor*

Calibration:
- Frequency of zero and span checks: *weekly*
- Is a transfer standard available? *yes*

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): *yearly*
If no, how is the calibration performed and how often:

Transfer standard:
- Method: *UV photometer*
- Manufacturer and model: *TEI*
- Is the standard traceable to a NIST Standard Reference Photometer (SRP): *yes*
- Location of primary calibration photometer: *Pollution Laboratory, Institute of Applied Environmental Research Stockholm University*
- How often is the transfer standard calibrated to a SRP: *yearly*

Data validation
Are the following data validation functions performed:
- Final data validation at site or other place: *at NILU*
- Consistency check(s), i.e:
  Graph plots *yes weekly*
  checked with instruments logbook *yes*

Land use at Norwegian background stations:

Birkenes (NO01): Height above sea level 190 m. Forest 65%, heather 10% cultivated land 10%, water 15%.

Tustervatn (NO15): Height above sea level 439 m. Forest 50%, graze 10%, cultivated land 10%, water 30%.

Jergul (NO30): last data collection in 1996, the data series continue at Karasjok (NO55).

Karvatn (NO39): Height above sea level 210 m. Forest 60%, graze 15%, heather 15%, cultivated land 8%, water 5%, built up areas 2%.

Osen (NO41): Height above sea level 440 m. Forest 70%, cultivated land 10%, water 20%.

Zeppelin (NO41): Height above sea level 474 m. Heather 60%, water 15%, built up areas 5%.

Prestebakke (NO43): Height above sea level 160 m. Forest 70%, grass 10%, heather 10%, houses etc 10%.

Nordmoen (NO44). Last data collection in 1999. Hurdal (NO56) is however rather close.

Jeloya (NO45) Height above sea level 5 m. Forest, grass, heather.

Hoylandet (NO46) Height above sea level 60 m. Forest 30%, heather 40%, water 5%, cultivated land 20%, built up areas 5%.

Svanvik (NO47): Height above sea level 30 m. Forest 50%, heather 30%, cultivated land 5%, water 10%, built up areas 5%.

Voss (NO48): Height above sea level 500 m. Forest 90%, heather/moss 10%.

Valle (NO49): Height above sea level 250 m.

Sogne (NO51): Height above sea level 15 m. Forest 50% and cultivated land 50%.

Sandve (NO52): Height above sea level 40 m. Forest, cultivated land, built up areas.

Karasjok (NO55): Height above sea level 333m. Forest 40%, heather 40%, built up areas 5%, cultivated land 5%, graze 5%, water 5%

Hurdal (NO56): Height above sea level 300m. Forest 95% and grass 5%.

Site: PL05 Diabla Gora

Surrounding area:
- Vegetation (forest, grass land etc): station is located on the meadow at the border of big forest complex
- Local sources of NO_x: foresters lodge building with a few cars coming every day (300 m from the station)
- Local topography (valley, hill etc): post-glacial (Baltic glaciation) landscape with front moraine relief

Instrumentation:
- Method: UV absorption photometry (254 nm)
- Manufacturer and model: Monitor Labs Inc. ML-9810
- Range: 0 – 1000 ppb
- Zero instability (per week): < 1 ppb
- Span instability (per week): 0.5% of readings
- Height of intake: 4.1 m
- Approximate distance from intake to monitor: 5 m
- Is the instrument in a temperature-controlled room? No.

Maintenance:
- Frequency of general maintenance:
  - Inlet filter exchange interval: 3 months
  - Leak test interval: 3 months
  - Frequency of checking the pressure transducer: every week
  - How often is the performance of the scrubber tested: 3 – 6 months

- Is a logbook at site? yes
- Which action are followed if a drift or instability is recognised: control of the instrument parameters, data correction according to the real results, instrument service

Calibration:
- Frequency of zero and span checks: zero checks – every week, span checks – not performed
- Is a transfer standard available? yes

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): every 3 months
If no, how is the calibration performed and how often: -

Transfer standard:
- Method: UV absorption photometry
- Manufacturer and model: Monitor Labs Inc. ML9811
- Is the standard traceable to a NIST Standard Reference Photometer (SRP): yes
- Location of primary calibration photometer: Czech Hydro-Meteorological Institute, Prague [SRP 17]
- How often is the transfer standard calibrated to a SRP: every year

Data validation
Are the following data validation functions performed:
- Final data validation at site or other place: yes, at the Institute of Environmental Protection in Warsaw (institute supervising the station)
- Consistency check(s), i.e:

  Graph plots : yes
  checked with instruments logbook : yes

Site: All Swedish stations

Parameter	Rörvik	Vavihill	Norra Kvill	Vindeln	Esrange	Aspvreten
Vegetation	Coastal, grassland	Grassland spot in beechforest	Grassland close to forest	Forestland	Hillside, very few sprucetrees	Forestland
Local sources of NOx	None	None	None	None	None	None
Local topography	Coast	South side of a ridge	Small hill	On a slope of an hill	On a hill	Small hill

Instrumentation

Method	UV	UV	UV	UV	UV	UV
Man. and model	ML 9810	ML 9810	ML 8810	ML 8810	ML 8810	9810 B
Range	0-1000 ppb	0-1000 ppb	0-1000 ppb	0-1000 ppb	0-1000 ppb	0-1000ppb
Zero inst	No checks	No checks	No checks	No checks	No checks	No checks
Span inst	No checks	No checks	No checks	No checks	No checks	No checks
Height of intake	5 m	5 m	5 m	3 m	4 m	5 m
Length of sample line	6 m	7 m	7 m	4 m	5 m	6 m
Room temp.	yes	Yes	yes	yes	yes	yes

Maintenance

Inlet filter	3 times/year
Leak test	3 times/year
Pressure	3 times/year
Scrubber test	3 times/year
Logbook	yes
Inst. recon.	Exchange instrument

Calibration

Freq. of span, zero	3 times/year
Transfer standard	Yes 3 times/year

Transfer standard

Method	UV
Model	Dasibi 1008 PC
Traceable	Yes
Location	ITM
Calibration	Once/year

Data validation

Final data	At IVL
Graph plots	yes
	Daily controls of the output from the stations through our alarm system

Site: (SI08) ISKRBA

Surrounding area:

- **Vegetation (forest, grass land etc):**
  The surrounding area is mostly forest (prevailingly coniferous trees). The rest is grass land (not grazed by domestic animals) and partly also farmland (grass, pasture).

- **Local sources of NO_x:**

Emission source	Distance	Comment
Small scale domestic heating with wood (3 occasionally occupied houses)	50 m	Emission of NO_x from firewood ca 3.6 kg/month during heating season.
Single line asphalt road	3 km	Traffic density 2000 vehicles/day
Single lane local asphalt road	5 km	Traffic density 300 vehicles/day
Small scale domestic heating with wood	1-10 km	Emission of NO_x ca 2.4 t/month throughout the year.

- **Local topography (valley, hill etc):**
  The site lies on a plateau at about 500 m a.s.l., surrounded by the hills and the mountains of 800-1200 m a.s.l.

Instrumentation:
- **Method:** UV absorption
- **Manufacturer and model:** Thermo Environmental Instruments, Model 49 C
- **Range:** 0-500 $\mu g/m^3$
- **Zero instability (per week):** < 2 ppb per week (manufacturer's specification)
- **Span instability (per week):** < 1 % per month (manufacturer's specification)
- **Height of intake:** 5.5 m above the ground and 1 m above a roof ridge of the hut.
- **Approximate distance from intake to monitor:** ca 5 m
- **Is the instrument in a temperature controlled room?** YES

Maintenance:
- **Frequency of general maintenance:**
  - **Inlet filter exchange interval:** 1 month
  - **Leak test interval:** 2 times per year (at calibration)
  - **Frequency of checking the pressure transducer:** 2 times per year (at calibration)
  - **How often is the performance of the scrubber tested:** once a year (or at maintenance)
- **Is a logbook at site?** YES; some information is noted down also on a strip chart at the site

- **Which action are followed if a drift or instability is recognised:**
  1. Filter change
  2. Leak test
  3. Scrubber test
  4. We try to find and resolve the problem at the site, otherwise a new analyser is installed and calibrated at the station.

Calibration:
- **Frequency of zero and span checks:** once per day
- **Is a transfer standard available?** YES

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): 2 times a year (multipoint calibration: zero & 6 points)
If no, how is the calibration performed and how often: -

Transfer standard:

- **Method:** UV absorption
- **Manufacturer and model:** Thermo Environmental Instruments, Model 49 CPS
- **Is the standard traceable to a NIST Standard Reference Photometer (SRP):** YES, NIST SRP #17
- **Location of primary calibration photometer:** Czech Hydrometeorological Institute, Prague
- **How often is the transfer standard calibrated to a SRP:** once per year

Data validation

Are the following data validation functions performed:

- **Final data validation at site or other place:**
  Ozone measurements are daily supervised at the site by a site operator. All irregular observations and information are recorded in a log book and on a strip chart. Measurement data are telemetrically transmitted every 30 minutes to the Hydrometeorological Institute of Slovenia and are also checked there on a daily basis. Documentation on all technical activities (maintenance of the sampling system, measurement of air flow through the sampling manifold, maintenance and calibration of ozone monitor, servicing etc.) is maintained at the Hydrometeorological Institute of Slovenia. Final data checking and validation is performed at the Hydrometeorological Institute at Slovenia. It consists of:
  1. visual inspection of the measurement data and zero/span stability on a strip chart,
  2. examination of major maintenance and servicing procedures at the site,
  3. examination of reports on calibration of ozone analyser at the site,
  4. examination of data on calibration against SRP and traceability to the primary standard,
  5. checking of graph plots and simple statistics, consistency checking etc.

  Measurement data are not flagged. Suspect data that are qualified as invalid are taken out from the final data base.

- **Consistency check(s), i.e:**
  Graph plots: YES
  Checked with instruments logbook : YES

Site: SI32 KRVAVEC

Surrounding area:

- **Vegetation (forest, grass land etc):**
  The surrounding mountain area is covered mostly by short grass (above 1600 m) and partly by coniferous forest (below 1600 m). The surrounding mountain peaks are rocky (limestone).

- **Local sources of NO_x:**
  In the winter time, some emissions of NOx originate from:
  - a residential heating at the TV transmitter (ca 2000 l of oil used during a heating season)
  - operation of a power generator (during power failure only),
  - skiing activities (motor skies, snow bulldozers etc.).

  Information on operation of the power generator is noted down on a strip chart that records ozone measurements. Based on this information, ozone data are validated accordingly (as invalid).

- **Local topography (valley, hill etc):**
  The site is situated about 30 km north of Ljubljana at an elevation of 1740 m a.s.l., on the ridge of the south-eastern Alps (Karavanke mountain ridge with peaks of 1500-2500 m a.s.l.).
  The measurement site is above the cold surface layer of air which forms in the Ljubljana basin. Sometimes, not very often, the inversion layer at the height of 2-3 km a.s.l. (caused by subsidence in a stable anticyclone) sinks below the height of the measuring site. During such events the site is usually in the clouds.

Instrumentation:

- **Method:** UV absorption
- **Manufacturer and model:** Thermo Environmental Instruments, Model 49 C
- **Range:** 0-500 $\mu g/m^3$
- **Zero instability (per week):** < 2 ppb per week (manufacturer's specification)
- **Span instability (per week):** < 1 % per month (manufacturer's specification)
- **Height of intake:** ca 10 m above the ground (3.5 m above a lower concrete plate)
- **Approximate distance from intake to monitor:** ca 8 m
- **Is the instrument in a temperature controlled room?** YES

Maintenance:

- **Frequency of general maintenance:**
  - **Inlet filter exchange interval:** 4 months
  - **Leak test interval:** 3 times per year (at calibration)
  - **Frequency of checking the pressure transducer:** 3 times per year (at calibration)
  - **How often is the performance of the scrubber tested:** once a year (or at maintenance)
- **Is a logbook at site?** YES; some information is noted down also on a strip chart at the site
- **Which action are followed if a drift or instability is recognised:**
  1.Filter change
  2.Leak test
  3.Scrubber test
  4.We try to find and resolve the problem at the site, otherwise a new analyser is installed and calibrated at the station.

Calibration:

- **Frequency of zero and span checks:** once per day
- **Is a transfer standard available?** YES

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): 3 times a year (multipoint calibration: zero & 6 points)

If no, how is the calibration performed and how often: -

Transfer standard:

- **Method:** UV absorption
- **Manufacturer and model:** Thermo Environmental Instruments, Model 49 CPS
- **Is the standard traceable to a NIST Standard Reference Photometer (SRP):** YES, NIST SRP #17
- **Location of primary calibration photometer:** Czech Hydrometeorological Institute, Prague
- **How often is the transfer standard calibrated to a SRP:** once per year

Data validation

Are the following data validation functions performed:

- **Final data validation at site or other place:**

  Ozone measurements are daily supervised at the site by a technician at TV transmitter station. All irregular observations and information are recorded in a log book and on a strip chart. Measurement data are telemetrically transmitted every 30 minutes to the Hydometeorological Institute of Slovenia and are also checked there on a daily basis. Documentation on all technical activities (maintenance of the sampling system, measurement of air flow through the sampling manifold, maintenance and calibration of ozone monitor, servicing etc.) is maintained at the Hydometeorological Institute of Slovenia. Final data checking and validation is performed at the Hydrometeorological Institute at Slovenia. It consists of:

  1. visual inspection of the measurement data and zero/span stability on a strip chart,
  2. examination of major maintenance and servicing procedures at the site,
  3. examination of reports on calibration of ozone analyser at the site,
  4. examination of data on calibration against SRP and traceability to the primary standard,
  5. checking of graph plots and simple statistics, consistency checking etc.

  Measurement data are not flagged. Suspect data that are qualified as invalid are taken out from the final data base.

- **Consistency check(s), i.e:**

  Graph plots: YES

  Checked with instruments logbook : YES

Site: SI33 KOVK

Surrounding area:

- **Vegetation (forest, grass land etc):** prevailingly forest, partly grassland and pasture
- **Local sources of NO_x:**
  The station lies ca 4 km E from the TE Trbovlje thermal power plant with total power of 125 MW. In 1998, emissions of NO_x amounted to 1,478 t and emissions of SO_2 amounted to 33,372 t. A direct influence of TPP emissions at Kovk measurement site is monitored by continuous measurements of NO_x and SO_2 concentrations in ambient air.
- **Local topography (valley, hill etc):** hilly

Instrumentation:

- **Method:** UV light absorption by O_3 molecules
- **Manufacturer and model:** Monitor Labs, Model 8810
- **Range:** 0-500 ppb
- **Zero instability (per week):** ± 3.5 ppb
- **Span instability (per week):** ± 5%
- **Height of intake:** 2.5 m above the ground
- **Approximate distance from intake to monitor:** 1.5 m
- **Is the instrument in a temperature controlled room?** YES

Maintenance:

- **Frequency of general maintenance:**
  - **Inlet filter exchange interval:** 1 month
  - **Leak test interval:** once a year
  - **Frequency of checking the pressure transducer:** once a year
  - **How often is the performance of the scrubber tested:** once a year

- **Is a logbook at site?** YES
- **Which action are followed if a drift or instability is recognised:**
  1. changing inlet filter,
  2. changing scrubber,
  3. servicing analyser, if necessary.

Calibration:

- **Frequency of zero and span checks:** once a day
- **Is a transfer standard available?** YES

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): once a year

If no, how is the calibration performed and how often: -

Transfer standard:

- **Method:** UV absorption
- **Manufacturer and model:** Thermo Environmental Instruments, Model 49 CPS (maintained at the Hydrometeorological Institute of Slovenia)
- **Is the standard traceable to a NIST Standard Reference Photometer (SRP):** YES, NIST SRP #17
- **Location of primary calibration photometer:** Czech Hydrometeorological Institute, Prague
- **How often is the transfer standard calibrated to a SRP:** once a year

Data validation

Are the following data validation functions performed:

- **Final data validation at site or other place:** YES, at the Milan Vidmar Electroinstitute

- **Consistency check(s), i.e:**
  Graph plots: YES
  Checked with instruments logbook : YES

Site: SI31 ZAVODNJE

Surrounding area:

- **Vegetation (forest, grass land etc):** prevailingly forest, partly grassland and pasture
- **Local sources of NO_x:**
  The station lies 8 km NW from the TE Šoštanj thermal power plant with total power of 745 MW. In 1998, emissions of NO_x amounted to 11,963 t and emissions of SO_2 amounted to 55,053 t. A direct influence of TPP emissions at Kovk measurement site is monitored by continuous measurements of NO_x and SO_2 concentrations in ambient air.

- **Local topography (valley, hill etc):** hilly

Instrumentation:

- **Method:** UV light absorption by O_3 molecules
- **Manufacturer and model:** Monitor Labs, Model 8810
- **Range:** 0-500 ppb
- **Zero instability (per week):** ± 3.5 ppb
- **Span instability (per week):** ± 5%
- **Height of intake:** 2.5 m above the ground
- **Approximate distance from intake to monitor:** 1.5 m
- **Is the instrument in a temperature controlled room?** YES

Maintenance:

- **Frequency of general maintenance:**
  - **Inlet filter exchange interval:** approximatelly 6 months
  - **Leak test interval:** once a year
  - **Frequency of checking the pressure transducer:** once a year
  - **How often is the performance of the scrubber tested:** once a year

- **Is a logbook at site?** YES
- **Which action are followed if a drift or instability is recognised:**
  1. changing inlet filter,
  2. changing scrubber,
  3. servicing analyser, if necessary.

Calibration:

- **Frequency of zero and span checks:** once a day
- **Is a transfer standard available?** YES

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): once a year
If no, how is the calibration performed and how often: -

Transfer standard:

- **Method:** UV absorption
- **Manufacturer and model:** Thermo Environmental Instruments, Model 49 CPS (maintained at the Hydrometeorlogical Institute of Slovenia)
- **Is the standard traceable to a NIST Standard Reference Photometer (SRP):** YES, NIST SRP #17
- **Location of primary calibration photometer:** Czech Hydrometeorological Institute, Prague
- **How often is the transfer standard calibrated to a SRP:** once a year

Data validation
Are the following data validation functions performed:

- **Final data validation at site or other place:** YES, at the Milan Vidmar Electroinstitute
- **Consistency check(s), i.e:**
  - **Graph plots:** YES
  - **Checked with instruments logbook :** YES

Sites: All Slovakian stations

Instrumentation:
- Method: UV absorption
- Manufacturer and model: TEI
  M49 - SK02; M49C – SK04; M49 - SK06
- Range: 0 – 500 ppb
- Zero instability (per week): -
- Span instability (per week): continual calibration
- Height of intake: approximately 3.5 – 4m
- Approximate distance from intake to monitor: from manifold to monitor 2 – 2.5m
- Is the instrument in a temperature controlled room? yes

Maintenance:
- Frequency of general maintenance: once per month
  - Inlet filter exchange interval: once per 2 – 3 weeks
  - Leak test interval: once per month
  - Frequency of checking the pressure transducer: once annually
  - How often is the performance of the scrubber tested: once annually

- Is a logbook at site? – maintenance will be registered starting this year
- Which action are followed if a drift or instability is recognised: optics and lamp are adjusted

Calibration:
- Frequency of zero and span checks: daily
- Is a transfer standard available? yes

If yes, how often is the instrument calibrated to the transfer standard (multipoint calibration): twice annually
If no, how is the calibration performed and how often: -

Transfer standard:
- Method: UV absorption
- Manufacturer and model: TEI; M49IS
- Is the standard traceable to a NIST Standard Reference Photometer (SRP): yes
- Location of primary calibration photometer: Czech Republic – Prague, CHMI
- How often is the transfer standard calibrated to a SRP: once annually.

Data validation
Are the following data validation functions performed:
- Final data validation at site or other place: in central data base in Bratislava
- Consistency check(s), i.e: -
  Graph plots
  checked with instruments logbook

Site: SK02 Chopok

- Vegetation: high mountainous alpine vegetation, grass land on acidic minerals.
- Local sources: none. Chopok does belong to the protected national park NAPANT (National Park of the Low Tatras).
- Local topography: central Slovakia, the crest of the Low Tatras, open to the south and to the north, rocky terrain. 2 008 m above sea level, 19° 35' 32" longitude, 48° 56' 38" latitude.

Station is included into EMEP network and GAW/BAPMoN/WMO network. Ozone has been monitored since 1994.

Site: SK04 Stará Lesná

- Vegetation: free land with mainly coniferous trees and scrubs, altered with grassy land of a high diversity.
- Local sources: local traffic to transport to a couple of hotels and small historical village 2 km northern. It is protected zone or so called buffer zone to the own territory of the High Tatras, belonging to to the protected national park TANAP (National Park of the High Tatras). It is biospheric reservation.
- Topography: slight slope, fore-mountain of the High Tatras. 808 m above sea level, 20° 17' 28" longitude, 49° 09' 10" latitude

Station is included into EMEP network. Ozone has been monitored since 1991.

Site: SK06 Starina

- Vegetation: trees up to 80%, mostly leafy and much less coniferous (only about 10%), partly permanent grass (10%) and rich soil (10%).
- Local sources: none. The station is located in the zone of drinking water reservoir Starina. The zone does belong to the zones of sanitary protection, it spreads on the territory of the protected national park Polonina, declared by UNESCO as the biospheric reservation. Nearby only the building of watershed of the rivers Bodrog and Hornád is situated.
- Local topography: east Slovakia, 345 m above sea level in hilly countryside, 22° 15' 35" longitude, 49° 02' 32" latitude.

Station is included into EMEP network. Ozone has been monitored since 1994.