

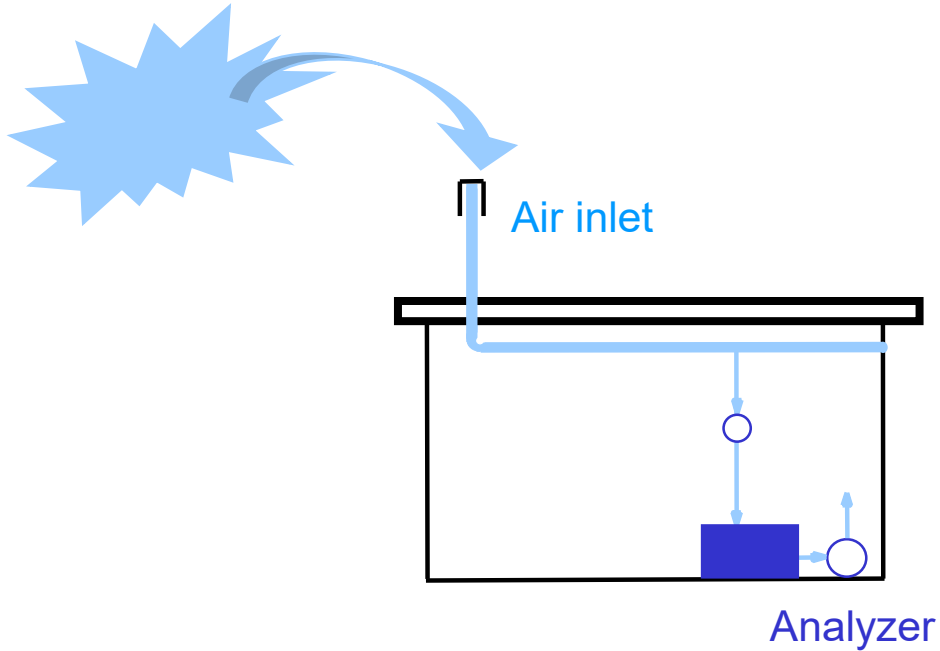
# Data handling and evaluation, measurements uncertainty

Martin Steinbacher

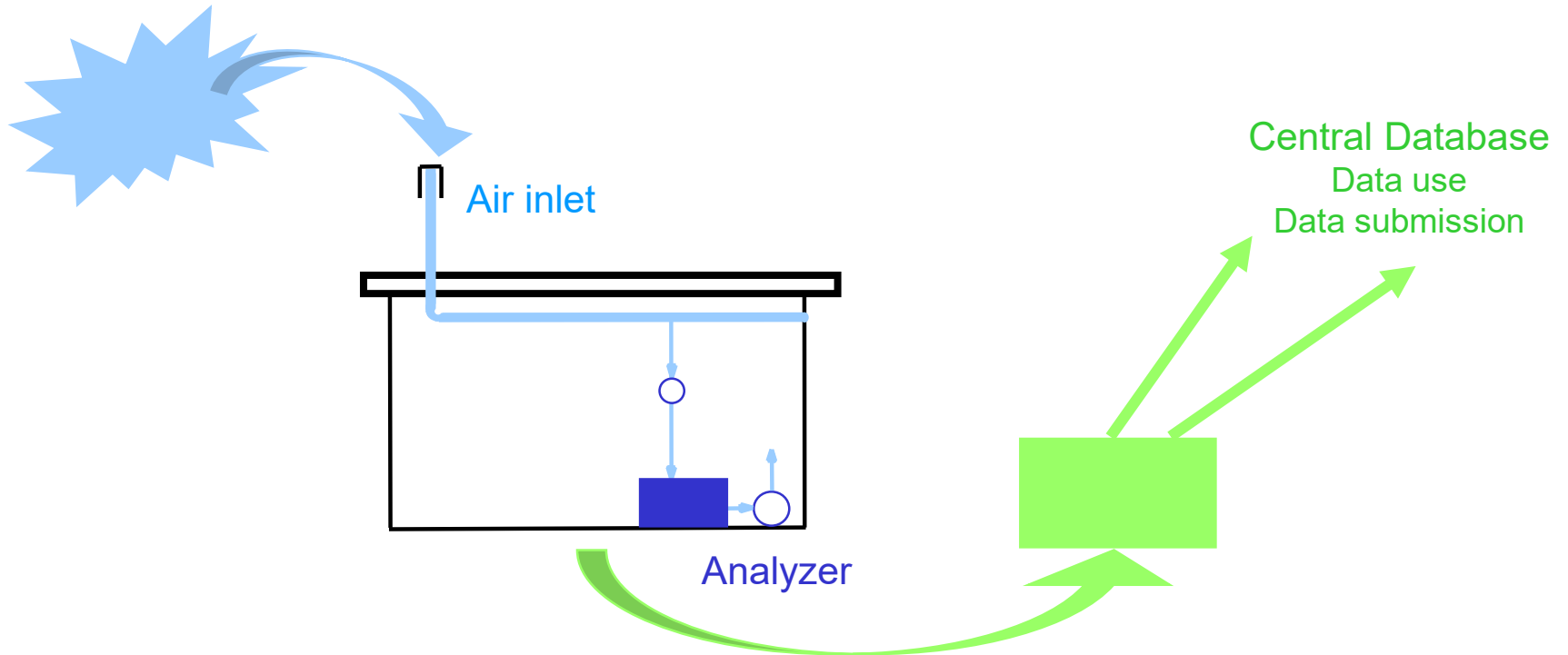
Empa, Laboratory for Air Pollution/Environmental Technology, Dübendorf,  
Switzerland

Training of KMD staff, Duebendorf, 28 June till 02 July 2018

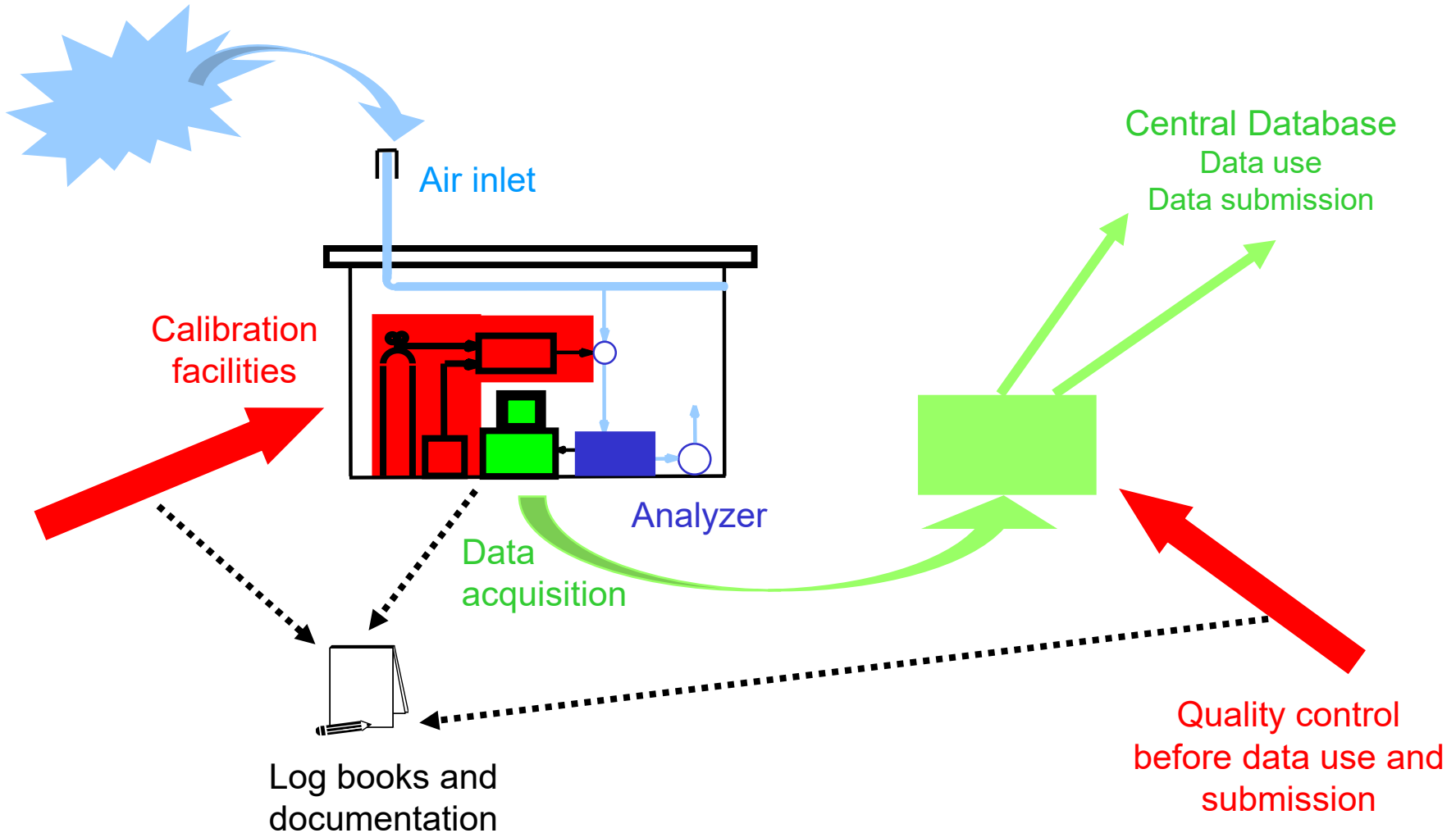
# Requirements for air quality measurements



# Requirements for air quality measurements



# Requirements for air quality measurements



# Contents

---

- maintenance
- documentation
- data format / data flagging
- uncertainty estimation
- use of other information

# Instrument Maintenance

---

- Maintenance is an important factor to ensure continuous operation of an instrument. It improves both data availability and data quality.
- Download and backup raw data.
- Visualize (raw) data with graph plots.
- Basic instrument checks
  - Check of general instrument operation
  - Leak check, flow checks, pressure sensor checks, status of calibration gases ...*
- Further maintenance
  - filter exchange, inlet line loss / tightness*
- Develop a maintenance scheme (check list) for the individual analyzers.
- Consult instrument manual for specific maintenance recommendations.

# Documentation – Meta data management

Wartungstool V1.29

2010-09-16 09:51:17

Wartungstool V1.29

2010-09-16 09:51:46

uwedat JUN mst

TEI 49C 14T 134-2.010067 03 TEI 49C 0330102717

Tourenplanung Geräteorte Tätigkeiten Formulare Hilfsmittel Datenabgleich Hilfe

Gerätekategorie: Ozon-Analysator TEI 49C

Regel	Gerätetyp	Variante	Gerätenummer	Seriennummer
0	Allg Ang u Bem 14T Station	*	134-2.000007	
0	Allg Kontrolle JUN 1 Station	*	134-2.000007	
0	APMA 370 14T	CD APMA 370	134-2.040041	ND1F9RHA
0	Cranox NOy 14T	CRA NOy-Konverter	134-2.090027	220.005
0	FH 621-R 14T	Schwebstaub FH 62	134-2.120028	385
0	HIVOL PM10 14T	HIVOL DA-80 HTD	134-2.170035	636
0	ML 9841A 14T	NOx ML 9841 A	134-2.020046	501/2608
0	Picarro G1301 14T	CO2/CH4/H2O Pica	134-2.070004	176-CFAD505
0	TEI 43C TL 14T	SO2 TEI 43C TL	134-2.030046	78238-388
0	TEI 49C 14T	O3 TEI 49C	134-2.010067	0330102717
0	TEI 49C 14T	O3 TEI 49C	134-2.010063	032550000001
1	FH 621-R Fluss-Kal	Schwebstaub FH 62	134-2.120028	385
0	Magnetventile	Station	134-2.000007	
0	MKAL GPT Durchfluss	MKAL GPT	134-2.060098	4142-05-04
0	MKAL VM Durchfluss	MKAL VM	134-2.060094	4170-05-01
0	Ringleit Pumpe Filter	Station	134-2.000007	
0	Teflonventile	Station	134-2.000007	
0	TEI 43C TL Druck	SO2 TEI 43C TL	134-2.030046	78238-388
0	TEI 43C TL Lüft-Filter	SO2 TEI 43C TL	134-2.030046	78238-388
0	TEI 49C Druck	O3 TEI 49C	134-2.010063	032550000001
0	TEI 49C Druck	O3 TEI 49C	134-2.010067	0330102717
0	TEI 49C Kal	O3 TEI 49C	134-2.010063	032550000001
0	TEI 49C Kal	O3 TEI 49C	134-2.010067	0330102717

Formular geladen F10 TEI 49C 14T.xls Grafik Drucken

### Ozon-Analysator TEI 49C

erfüllt

Gerät fehlerfrei in Betrieb (oder Alarm):

Temperatures: Bench: 15 bis 45 °C ..... °C  
 Bench Lamp: 50 bis 60 °C ..... °C

Pressure: einige mm Hg unter dem Umgebungsdruck:  mbar ..... mm Hg

Flows: Cell A 0.5 bis 1.2 l/Min. .... l/Min.  
 Cell B 0.5 bis 1.2 l/Min. .... l/Min.

Intensities: Cell A 65 bis 150 kHz ..... kHz  
 Cell B 65 bis 150 kHz ..... kHz

Kalibration: Sollwert:  ppb O<sub>3</sub>

Nullwert:  ppb O<sub>3</sub> Alt  ppb O<sub>3</sub> Neu  ppb O<sub>3</sub> O3 BKG ppb:  Alt  Neu  
 Spanwert:  ppb O<sub>3</sub> O3 COEF:  Alt  Neu

Korrekturfaktor:

Bemerkungen:

### Kontrollwerte

Formular geladen Namen: 34 Werte: 0 Referenzen: 0 Ref. fehlt: 1

# Documentation – Meta data management

[El Tololo](#) | [Pha Din](#) | [LGR\\_N2O\\_CO\\_23r](#)  
 Electronic Logbook Los Gatos Research N2O/CO analyzer 23r, Page 1 of 1

[New](#) | [Find](#) | [Select](#) | [Import](#) | [Config](#) | [Last day](#) | [Help](#)

[Full](#) | [Summary](#) | [Threaded](#)

 -- All entries --
  -- Type --
 **20 Entries**

ID	Date	Author	Type	Category	Subject	Event Date	Text
20	3/26/2013 12:46:21 PM	mst134	MultiPortUnit	Tests	overflow checks	3/26/2013 12:46:15 PM	flows measured with ADM3000 membrane flowmeter after measurements stopped; ports selected by activating the port with the hardware
19	1/10/2013 8:22:52 AM	mst134	N2O/CO-23d	General	Passwords	1/9/2013 10:21:20 AM	New passwords set under the Linux Environment lgr: su:
18	1/9/2013 10:41:08 PM	mst134	MultiPortUnit	CalgasPressure	pressure in reference gases	1/9/2013 10:39:58 AM	port; gas; regulator; upstreamP; downstreamP; overflow [ml/min]; comments port2; E-085; SS1412151; 142; 2;
17	12/19/2012 11:51:41 AM	mst134	N2O/CO		transmitted intensity		maintenance parameters according to instrument manual 'daily operation checklist' transmitted
16	12/19/2012 11:48:23 AM	mst134	N2O/CO				
15	12/19/2012 11:38:00 AM	mst134	N2O/CO				
14	12/7/2012 3:04:31 PM	mst134	N2O/CO	Tests	overflow checks		
13	12/7/2012 2:04:12 PM	mst134	MultiPortUnit				
12	12/7/2012 2:02:16 PM	mst134	N2O/CO				flows measured with ADM3000 membrane flowmeter after measurements stopped; ports selected by activating the port with the hardware switch inside the multiportunit port; gas; regulator; upstreamP; downstreamP; overflow [ml/min]; comments port2; E-085; SS1412151; 135; 2.0; old: 95-120 : new 95-120 port3; E-088; SS1415788; 100; 2.0; old: 120-180 : new 55-80 port4; E-087; SS1412132; 82; 2.2; old: 200 : new: 80 - 110 port5; E-084; SS1417489; 77; 2.0; old: no overflow (downstreamP drops to 1.2bar, when reset to 2bar, overflow 150 : new: 40-70; target gas
11	12/4/2012 9:20:25 AM	mst134	N2O/CO				flows while measuring; ports selected by activating the port with the hardware switch inside the multiportunit port; gas; regulator; upstreamP; downstreamP; overflow [ml/min]; comments port2; E-085; SS1412151; 135; 2.0; 90 port3; E-088; SS1415788; 100; 2.0; 35 port4; E-087; SS1412132; 82; 2.2; 55 port5; E-084; SS1417489; 77; 2.0; old: no overflow : new: 30; target gas
10	10/5/2012 8:55:58 AM	mst134	N2O/CO				
9	8/16/2012 12:49:23 PM	mst134	N2O/CO				
8	8/8/2012 5:08:37 PM	mst134	N2O/CO				

[El Tololo](#) | [Pha Din](#) | [LGR\\_N2O\\_CO\\_23r](#)  
 Electronic Logbook Los Gatos Research N2O/CO analyzer 23r

Fields marked with \* are required

Entry time: 3/26/2013 12:46:21 PM

Author\*: mst134

Type\*: MultiPortUnit

Category: Tests

Subject: overflow checks

Event Date: March 26 Year: 2013 12 : 46 : 15

flows measured with ADM3000 membrane flowmeter after measurements stopped; ports selected by activating the port with the hardware switch inside the multiportunit  
port; gas; regulator; upstreamP; downstreamP; overflow [ml/min]; comments  
port2; E-085; SS1412151; 135; 2.0; old: 95-120 : new 95-120  
port3; E-088; SS1415788; 100; 2.0; old: 120-180 : new 55-80  
port4; E-087; SS1412132; 82; 2.2; old: 200 : new: 80 - 110  
port5; E-084; SS1417489; 77; 2.0; old: no overflow (downstreamP drops to 1.2bar, when reset to 2bar, overflow 150 : new: 40-70; target gas

flows while measuring; ports selected by activating the port with the hardware switch inside the multiportunit  
port; gas; regulator; upstreamP; downstreamP; overflow [ml/min]; comments  
port2; E-085; SS1412151; 135; 2.0; 90  
port3; E-088; SS1415788; 100; 2.0; 35  
port4; E-087; SS1412132; 82; 2.2; 55  
port5; E-084; SS1417489; 77; 2.0; old: no overflow : new: 30; target gas

Encoding:  HTML  ELCode  plain  
 Suppress Email notification  Resubmit as new entry

Attachment 1:

ELOG V2.9.2-2455



# Documentation – Meta data management

The screenshot shows a VMware Player window titled 'Ubuntu1004 - VMware Player'. Inside, an Ubuntu desktop environment is visible. A file manager window titled '/agage/jung - GCWerks (Empa)' is open, showing a directory listing on the left and a log file in the main pane. The directory listing includes 'operations log', 'tank press log', 'ports log', 'hardware info', and '1201'. The log file contains the following text:

```
10.01.2012 (mst-jun)
check equilibration time for std.9: 70 seconds -> OK

20.03.2012 (mst-rem)
measurement shutdown after run 1523 due to envisaged power outage in the evening

21.03.2012 (mst-rem)
restart of measurements with run 0826 to check if it runs fine again
measurement shutdown in order to save working standard gas as it is about to run empty

11.04.2012 (mst-jun)
restart of measurements, no peaks for ECD channel, ECD temperature 47C (setpoint was set to 4C !)
ECD temp setpoint set to 395C -> ECD temp comes up
pump for ambient air samples (KNF N86KTE, S/N 2.0583297) is broken; dismantled and brought back to Empa -> no ambient air measurements currently possible
new working std connected to port11
afternoon old working std (E-064), port9 as std measured vs. new working std E-073, port11
shutdown after run 2008

20.04.2011 (mst-jun)
new KNF pump installed, KNF N86KTE, SN 2.0614395, i.e. membrane PTFE, valve and flippers Kalrez, equilibration time 50sec
once more old std E-064 v(as std on port 9) vs new std (E-073 (as tank on port 11).
equilibration time E-064: 60sec, E-073: 65sec

23.04.2012 (mst-rem)
timefile, i.e. regular target tank measurements enabled.

29.04.2012
approx. 3h10 Local Winter Time till 15h20 LWF: power failure

01.05.2012 (mkv-rem)
Announced power failure. stopped run before power cut. Power was cut at 18:15 LT and lasted at least 40 min (see medusa UPS).
After that mkv finds jung to be running again, so mfi must have restarted the instrument and the runs (unclear if the entire
instrument was off, may need to check back with mfi).

11.05.2012 (mst-jun)
port of working std changed (before 11, now 9) as it was connected to a temporary port (and tube) as long as
the previous working std was still hooked up. downstream pressure 1bar, equilibration time 65sec
#
check equilibrationtime for air measurements: 50sec -> OK

06.06.2012 (mkv-rem): announced power outage. Must have resulted in instrument shutdown. mfi must have restarted computer. mkv restarts device
drivers and restarts measurements (with an additional std at beginning, will likely have to be flagged).

18.06.2012 (mst-rem, Urs0tz-jun)
flame of FID off, Urs reignites flame

18.06.2012 till 19.06.2012 0750
ecd3 and 4 don't change their setpoints, reason unknown
functionality comes back again without intervention
```

The file manager window also shows a status bar at the bottom indicating '1201 (9 files)' and navigation buttons for 'Instrument', 'Chromatograms', 'Stripchart', 'Results', and 'Edit'. The VMware Player window title bar includes 'File' and 'Help' menus, and a search bar with buttons for 'Save As', 'Save Changes', and 'Delete File'. The desktop background is blue, and various icons are visible on the left side, including 'Computers', 'mst134's Home', 'Network Settings', 'Terminal', 'Take Screenshots', 'Firefox', 'Trash', and 'gasverbrau emp.a.o'.

# Data flagging

---

- Data need to be flagged for further data analysis.
- Ancillary instrument information (e.g. flows, temperatures, state of calibration valves) should be recorded by the data acquisition system for efficient data analysis.
- “Valid ambient data” should be used for scientific studies and data submission.
- All other data should NOT be deleted, but remain the data base with appropriate flags.

# Uncertainty

---

- All data that is submitted / published / used should be associated with an uncertainty.
- However, data are often submitted or published without any uncertainty information.

# Uncertainty

- ISO Guide for the Expression of Uncertainty in Measurements (GUM)
- Freely available on BIPM website  
<http://www.bipm.org/en/publications/guides/gum.html>

The screenshot shows the BIPM website interface. At the top, there is a search bar with the text "New search facility: BIPM metrology portal" and a search icon. Below the search bar, there is a navigation menu with various categories: METRE CONVENTION, CIPM MRA, COMMITTEES, BIPM, SCIENTIFIC WORK, SI, PUBLICATIONS, and DATABASES. The main content area is titled "GUM: Guide to the Expression of Uncertainty in Measurement" and includes a "Version française" link. The page is divided into several sections: a "Summary" section with links to the GUM guide, VIM 3, and bibliographies; a "Direct access" section with a list of links to various BIPM resources; and a list of documents related to the GUM, including the main guide and several supplementary documents. A note at the bottom states: "Interested readers are also referred to the JCGM-WG1's [Bibliography on Uncertainty](#)."

# Terminology

<http://gaw.empa.ch/glossary/glossary.html>

EN DE FR

KONTAKT INTRANET LOGIN

Q

SEARCH



Materials Science and Technology

OVERVIEW

RESEARCH ▾

PUBLICATIONS

TEAM ▾

Empa > 500 - Mobility, Energy and Environment > 503 - Air Pollution / Environmental Technology > Research > Global Atmosphere Watch > [gaw\\_glossary](#)



Empa > 500 - Mobility, Energy and Environment > 503 - Air Pollution / Environmental Technology > Research > Global Atmosphere Watch > [gaw\\_glossary](#)

## WMO/GAW Glossary of QA/QC-Related Terminology

Version 1.0 2010-09-14 (last update: 2016-05-26 (minor changes, see [Version history](#) for details))

Editors: [J. Klausen](#), [H.-E. Scheel](#) and [M. Steinbacher](#)

### Table of Contents

[Introduction](#)

[Glossary](#)

- [Alphabetical list of terms](#)
- [SECTION 1 - Quantities and Units](#)
- [SECTION 2 - Measurement](#)
- [SECTION 3 - Devices for Measurement](#)

# Terminology

---

<http://gaw.empa.ch/glossary/glossary.html>

## Glossary

Alphabetical list of terms

accuracy | adjustment of a measuring system | audit | calibration | calibration curve | calibration hierarchy | Central Calibration Laboratory (CCL) | certified reference material | combined standard measurement uncertainty | concentration | conventional quantity value | conventional reference scale | correction | coverage factor | coverage interval | coverage probability | data quality objectives (DQOs) | definitional uncertainty | expanded measurement uncertainty | indication | input quantity in a measurement model | international system of units | laboratory standard | measurand | measured quantity value | measurement | measurement accuracy | measurement bias | measurement error | measurement guideline (MG) | measuring instrument | measurement precision | measurement procedure | measurement repeatability | measurement reproducibility | measurement result | measurement trueness | measurement standard | measuring system | measurement uncertainty | metrological comparability of measurement results | metrological compatibility of measurement results | metrological traceability | metrological traceability chain | (mass) mixing ratio | (volume) mixing ratio | mole fraction | nominal quantity value | ordinal quantity | output quantity in a measurement model | precision | primary measurement standard | quality assurance | quality control | quantity | quantity value | random measurement error | reference material | reference measurement standard | reference quantity value | reference scale | repeatability condition of measurement | reproducibility condition of measurement | resolution | secondary measurement standard | sensitivity of a measuring system | selectivity of a measuring system | (measurement) standard | standard measurement uncertainty | standard operating procedure (SOP) | standard scale | surveillance cylinder | systematic measurement error | target cylinder (target gas) | tertiary standard | transfer measurement device | travelling measurement standard | true quantity value | Type A evaluation of measurement uncertainty | Type B evaluation of measurement uncertainty | World Calibration Centre (WCC) | working measurement standard | zero adjustment of a measuring system

# Terminology - Example

<http://gaw.empa.ch/glossary/glossary.html>

## [4.13] selectivity of a measuring system #top#

### selectivity

property of a →measuring system, used with a specified →measurement procedure, whereby it provides measured →quantity values for one or more →measurands such that the values of each measurand are independent of other measurands or other →quantities in the phenomenon, body, or substance being investigated [1]

### EXAMPLES

1. Capability of a measuring system including a mass spectrometer to measure the ion current ratio generated by two specified compounds without disturbance by other specified sources of electric current.
2. Capability of a measuring system to measure the power of a signal component at a given frequency without being disturbed by signal components or other signals at other frequencies.
3. Capability of a measuring system for ionizing radiation to respond to a given radiation to be measured in the presence of concomitant radiation.
4. Capability of a mass spectrometer to measure the amount-of-substance abundance of the  $^{28}\text{Si}$  isotope and of the  $^{30}\text{Si}$  isotope in silicon from a geological deposit without influence between the two, or from the  $^{29}\text{Si}$  isotope.

### NOTES

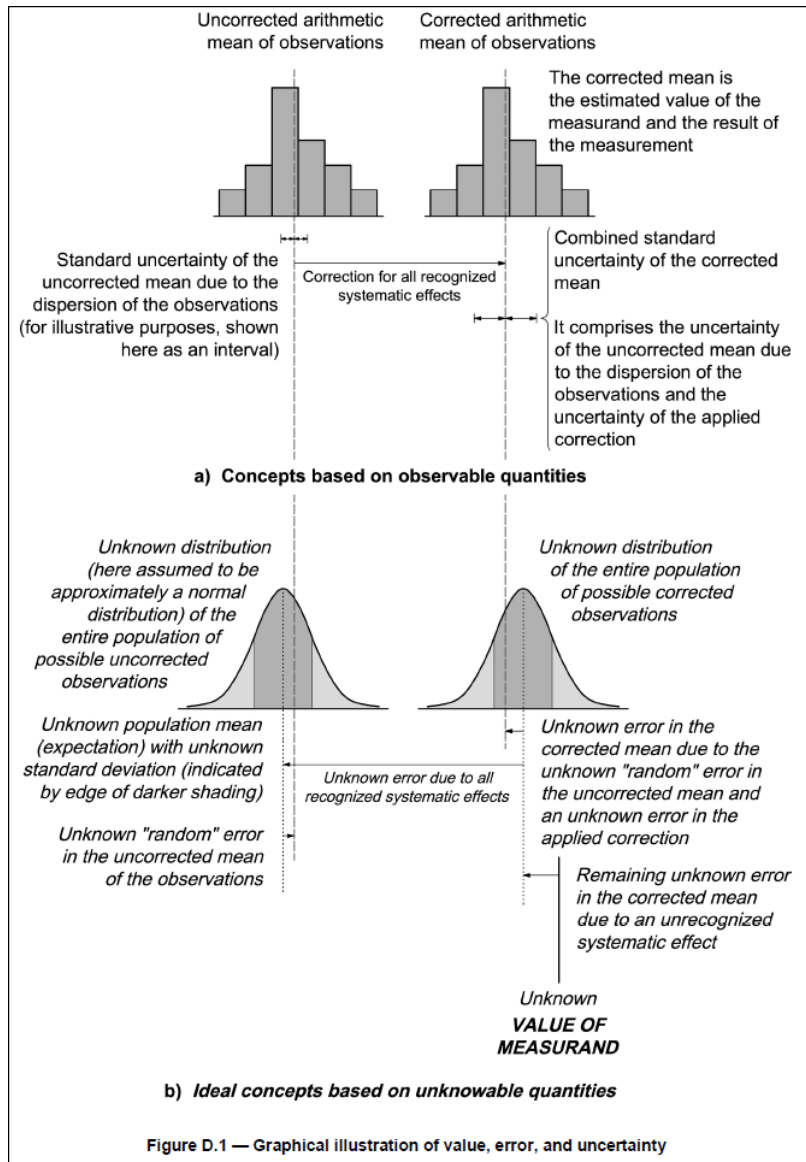
1. In physics, there is only one measurand; the other quantities are of the same kind as the measurand, and they are input quantities to the measuring system.
2. In chemistry, the measured quantities often involve different components in the system undergoing measurement and these quantities are not necessarily of the same kind.
3. In chemistry, selectivity of a measuring system is usually obtained for quantities with selected components in concentrations within stated intervals.
4. Selectivity as used in physics (see Note 1) is a concept close to specificity as it is sometimes used in chemistry.

### EXAMPLES (GAW)

1. A measuring system is highly selective for a specific trace gas (e.g. CO) mole fraction if its quantity value (e.g. 2 nmol/mol) is independent on quantity changes of the sample matrix (e.g. humidity changes).
2. Capability of gas chromatographic system to fully separate the peak of substance A from substance B in a chromatogram.



# Uncertainty



- See ISO Guide for the Expression of Uncertainty in Measurements (GUM)



# Example: Uncertainty of CO measurements

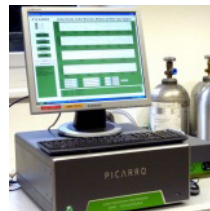
- Different factors contribute to the overall uncertainty of the measurements:



- Primary lab standard



- Secondary lab standard
- Zero air



- Repeatability
- Drift (zero)
- Drift (span)
- Linearity / deviation from the calibration function
- Pressure dependency
- Temperature dependency
- Interferences

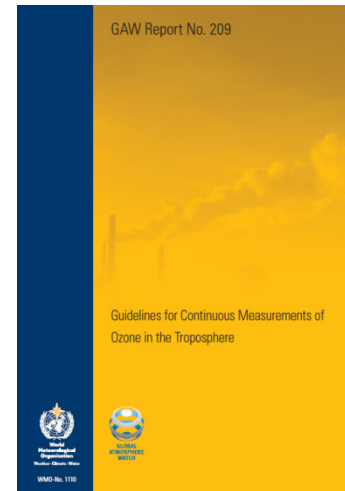


- Sampling (artifacts, inlet loss etc.)

# Example: Uncertainty of surface O<sub>3</sub> measurements

## 9.4.3 Combined standard uncertainty of the ozone analyser

The uncertainty budget of the ozone analyser can also be estimated by combination of the contributions of the individual uncertainty components. An example of an assessment for an ozone analyser operated in the Swiss National Monitoring network is given below. The individual contributions to the combined standard uncertainty were estimated by either experimental data, manufacturer specifications or, in cases where no data was available, by expert judgment. Table 1 summarises the uncertainty budget for the measurement of ozone mole fractions [...]. The uncertainty components have been combined according to the methodology proposed by the Joint Committee for Guides in Metrology (2008).



# Example: Uncertainty of surface O<sub>3</sub> measurements

Table 1 - Example of an uncertainty budget of an ozone analyser

Component (y)	Source	Distribution	Contribution to $u(x)$
Imperfect calibration / linearity	Comparison between TS and OA	Rectangular	$0.0017 \cdot x^*$
Repeatability	Instrument stability	Rectangular	$0.0016 \cdot x$
Span drift	Instrument stability	Rectangular	$0.0040 \cdot x$
Zero drift	Instrument stability	Rectangular	0.17
Pressure $P$	Pressure measurement	Rectangular	$0.0002 \cdot x$
Temperature $T$	Temp. measurement	Rectangular	$0.0005 \cdot x$
H <sub>2</sub> O interference	Interference in the UV		$0.0060 \cdot x$
Other interferences	Interference in the UV		0.6
Sampling loss (Inlet)	Inlet material, dirt	Rectangular	$0.0014 \cdot x$

\* where  $x$  refers to ozone mole fraction

A conservative estimate of the total uncertainty can now be obtained by combing the uncertainties of the ozone analyser (13), the transfer standard (12) and the primary reference (11).

$$u(O_3) = \sqrt{(0.81)^2 + (0.0089 \times O_3)^2} \text{ nmol mol}^{-1} \quad (14)$$

GAW Report No. 209

Guidelines for Continuous Measurements of Ozone in the Troposphere



WMO No. 110

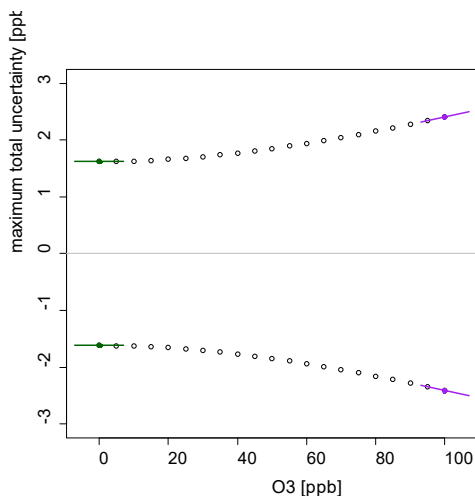
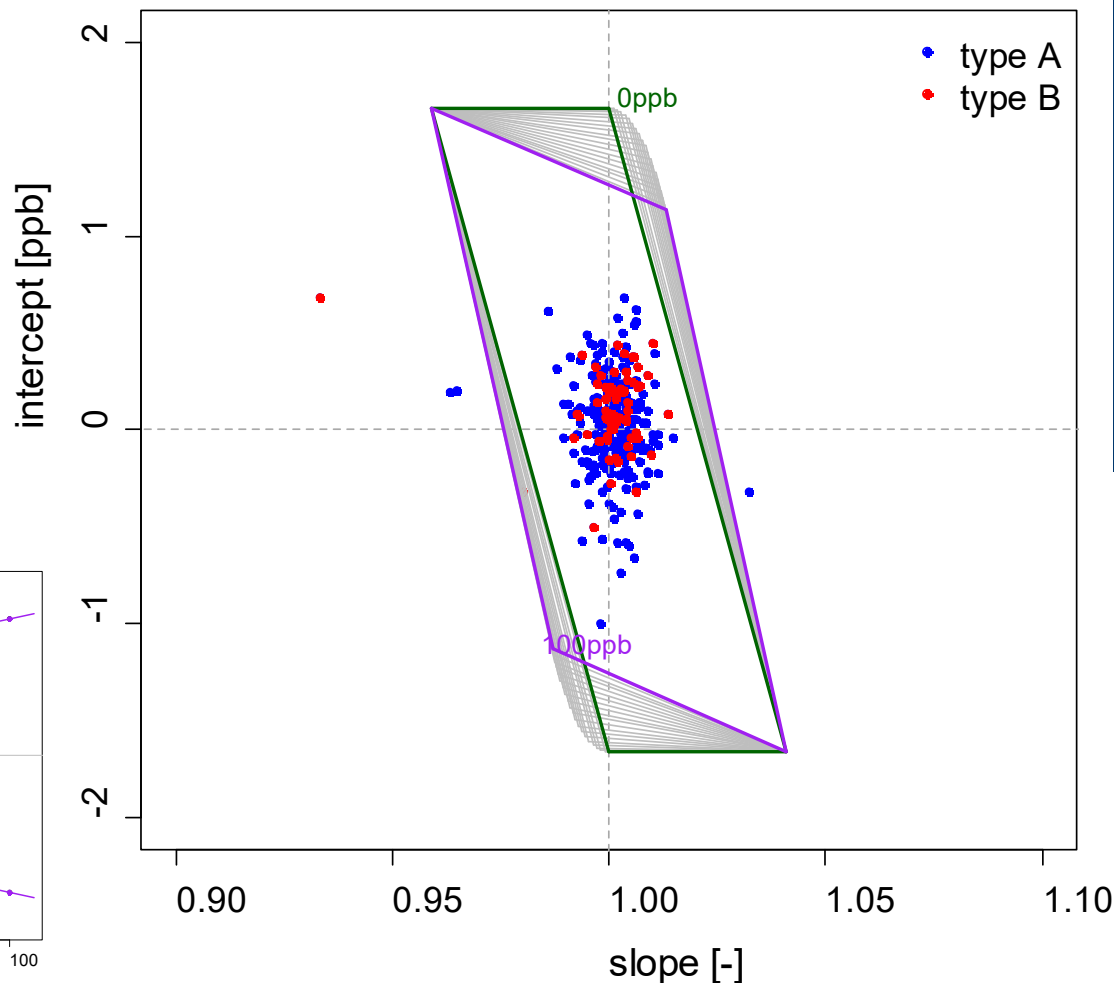
# Example: Uncertainty of surface O<sub>3</sub> measurements

GAW Report No. 209

Guidelines for Continuous Measurements of  
Ozone in the Troposphere



WMO No. 119



**Figure 7 - Intercept vs. slope plot for 296 calibrations of various ozone analysers with transfer standards within the Swiss National Air Pollution Monitoring Network between November 2005 and November 2011 for two different types of UV absorption ozone instruments. The grey lines correspond to the uncertainties from Equation (14), expanded by a coverage factor  $k=2$  for ozone mole fractions from 0-100 ppb. The uncertainties for 0 ppb and 100 ppb are highlighted in green and purple, respectively**

# From the GUM (3.4.8)

---

- Although this Guide provides a framework for assessing uncertainty,
  - it cannot substitute for critical thinking, intellectual honesty and professional skill.
  - the evaluation of uncertainty is neither a routine task nor a purely mathematical one
  - it depends on detailed knowledge of the nature of the measurand and of the measurement.
  - the quality and utility of the uncertainty quoted for the result of a measurement therefore ultimately depend on the understanding, critical analysis, and integrity of those who contribute to the assignment of its value.

# Comparison with other sites

<https://ds.data.jma.go.jp/gmd/wdcdgg/>

**WMO Global Atmosphere Watch**  
**World Data Centre for Greenhouse Gases**

**Welcome to the WDCGG Web Site**

The World Data Centre for Greenhouse Gases (WDCGG) is one of the WDCs under the GAW programme. It serves to gather, archive and provide data on greenhouse gases (CO<sub>2</sub>, CH<sub>4</sub>, CFCs, N<sub>2</sub>O, etc.) and related gases (e.g., CO) in the atmosphere and ocean, as observed under GAW and other programmes.

This web site provides information on greenhouse gases, including WDCGG publications and measurement data contributed by organizations and individual researchers around the world.

If you would like to submit data for the first time, please refer to the WDCGG Data Submission and Dissemination Guide.

Please let us know if you would like to obtain older versions of archived data.

The WDCGG starts operation as [DCPC \(Data Collection or Production Centre\) of WMO Information System](#).

**Note:** On any publication using data from the individual station, the author must contact the data submitters concerning co-authorship or acknowledgements, and make proper descriptions on the data sources in their references.

From January 1st 2016, the responsibility related to archiving of reactive gases measurement data(except for CO) is transferred to [the newly established GAW World Data Centre for Reactive Gases \(WDCRG\)](#) hosted by the Norwegian Institute for Air Research (NILU). [Click here for the WMO official letter on this transfer.](#)

[WDCGG Data Submission and Dissemination Guide](#)

# Comparison with other sites

<https://ds.data.jma.go.jp/gmd/wdogg/>

The screenshot shows the WMO Global Atmosphere Watch World Data Centre for Greenhouse Gases website. The page features a navigation menu on the left with options: Introduction, Contributors, Data/Quick Plot, Catalogue Search, Form Search, Map Search (highlighted with a red circle), Advanced Search and Plot, Data Archives, Sample Programs, and Global Mean Mea. The main content area is titled 'Map Search' and includes a search interface with dropdown menus for Zoom (Global), Station Category (Stationary), Parameter (O3), and Contributor. A 'Redraw' button is also present. Below the search controls is a world map displaying numerous data points, with red dots indicating stations updated in the last 365 days. A legend at the bottom explains the red dot symbol and provides a link for mobile stations.

WMO Global Atmosphere Watch  
World Data Centre  
for Greenhouse Gases

**Map Search**

Zoom: Global | Station Category: Stationary | Parameter: O3 | Contributor: | Redraw

90°N  
60°N  
30°N  
0°  
30°S  
60°S  
90°S

0° 30°E 60°E 90°E 120°E 150°E 180° 150°W 120°W 90°W 60°W 30°W

WMO WDCGG / Japan Meteorological Agency

The symbol "•" denotes that the data from the station has been updated in the last 365 days.

[As to the search for mobile stations, please click here.](#)

# Comparison with other sites

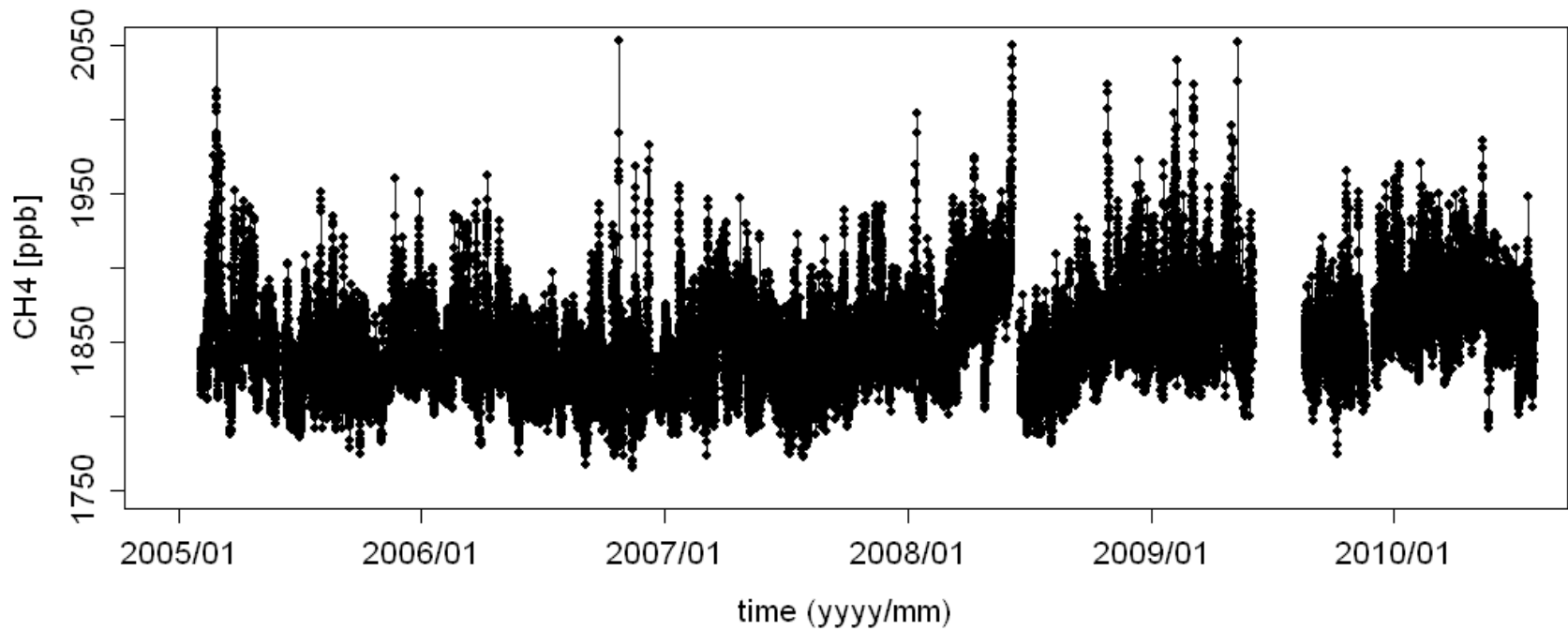
<https://ds.data.jma.go.jp/gmd/wdogg/>

The screenshot shows the WMO Global Atmosphere Watch World Data Centre for Greenhouse Gases website. The page features a navigation menu on the left with options like 'Introduction', 'Contributors', 'Data/Quick Plot', 'Catalogue Search', 'Form Search', 'Map Search', 'Advanced Search and Plot', 'Data Archives', 'Sample Programs', and 'Global Mean Mole Fractions'. The main content area is titled 'Map Search' and includes search filters for 'Zoom' (Global), 'Station Category' (Stationary), 'Parameter' (O3), and 'Contributor'. A 'Redraw' button is also present. Below the filters is a world map with a grid showing station locations as blue dots. A legend at the bottom of the map states: 'The symbol "•" denotes that the data from the station has been updated in the last 365 days.' A link at the bottom of the map area says: 'As to the search for mobile stations, please click here.'



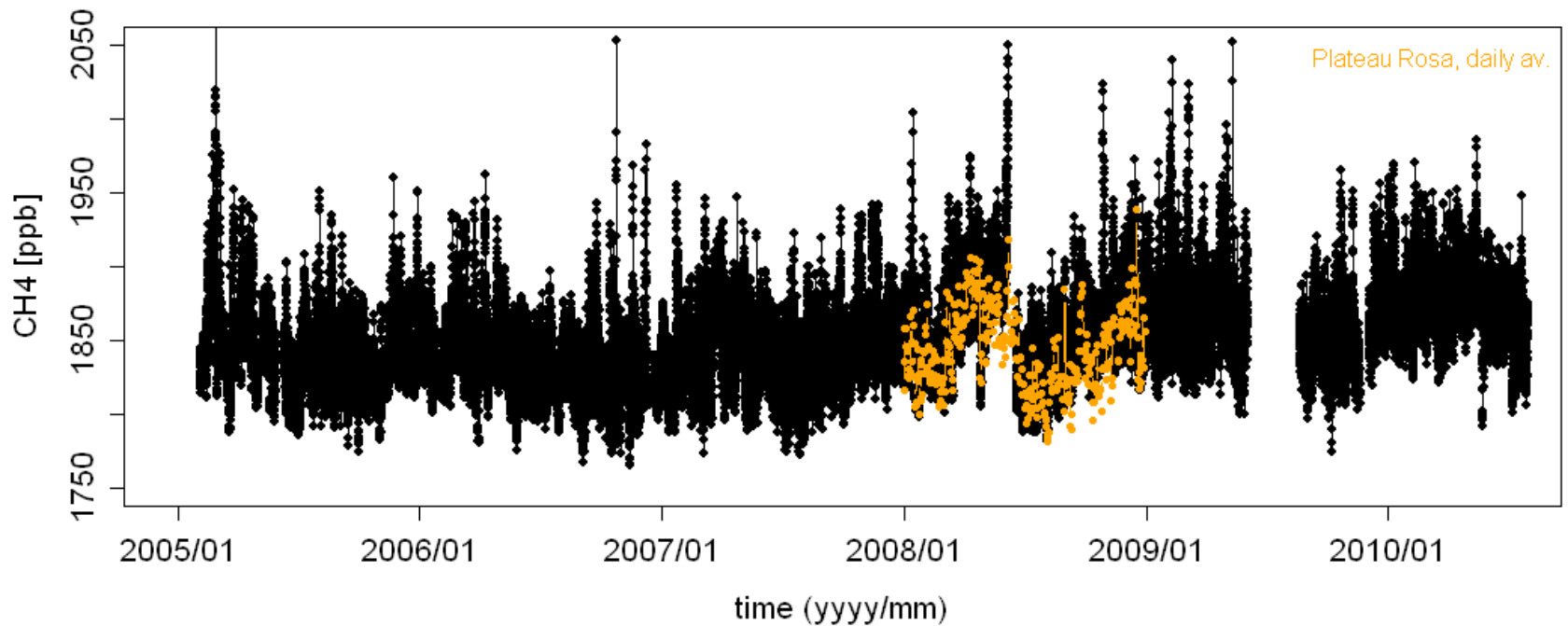
# Comparison with other sites

- it works well for longer lived species



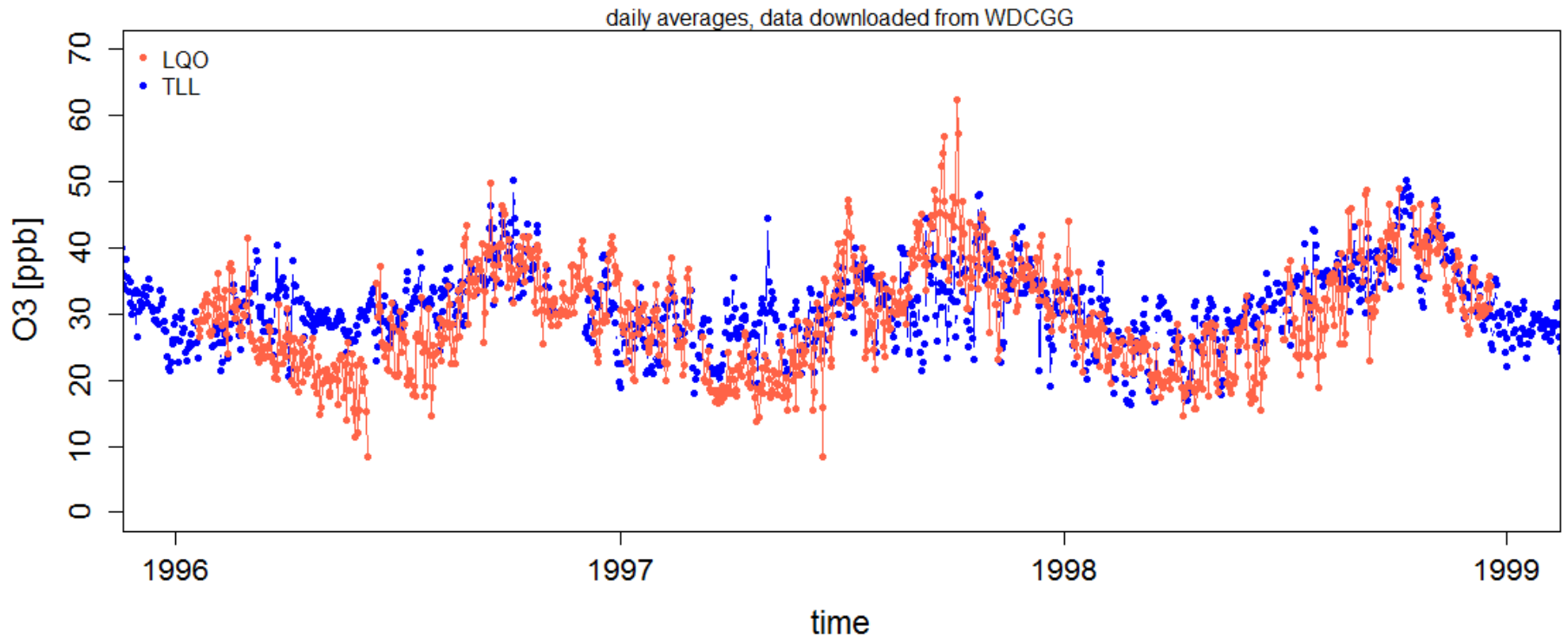
# Comparison with other sites

- it works well for longer lived species



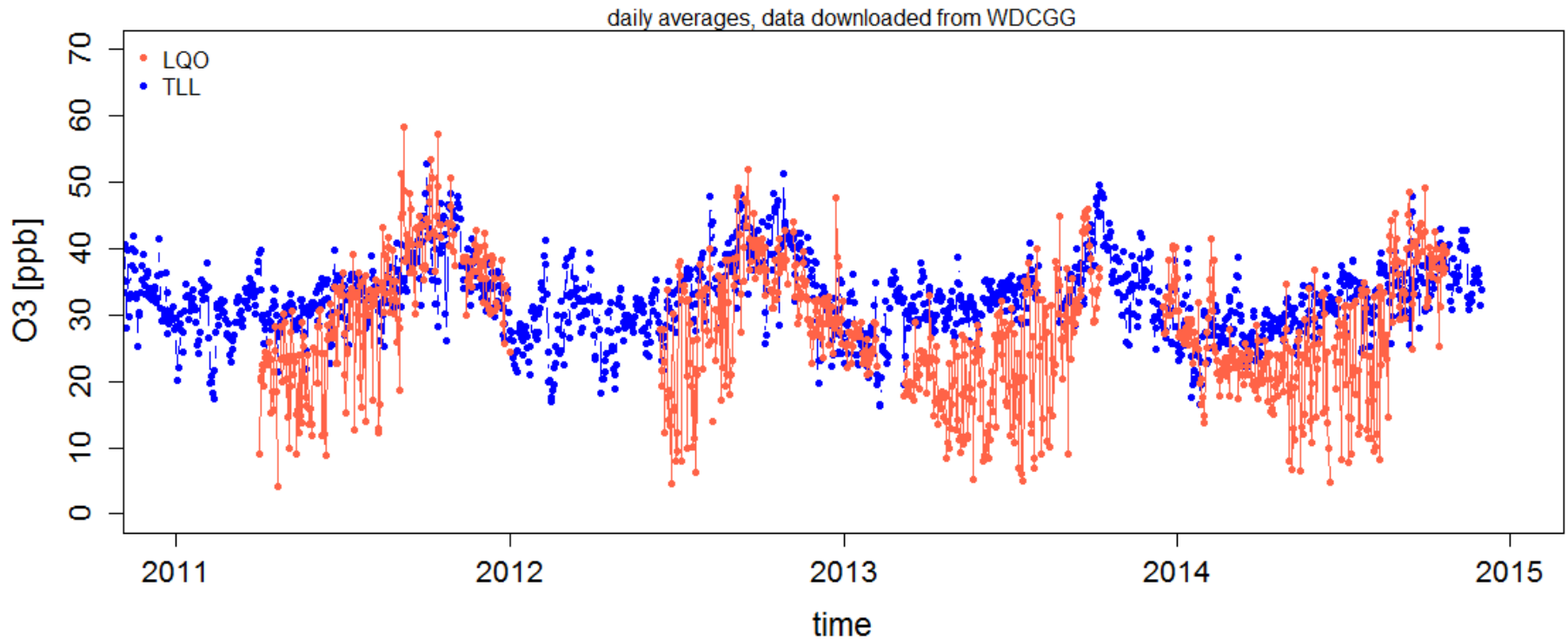
# Comparison with other sites

- Large variability due to (local) formation and depletion of ozone makes a comparison more complex



# Comparison with other sites

- Large variability due to (local) formation and depletion of ozone makes a comparison more complex

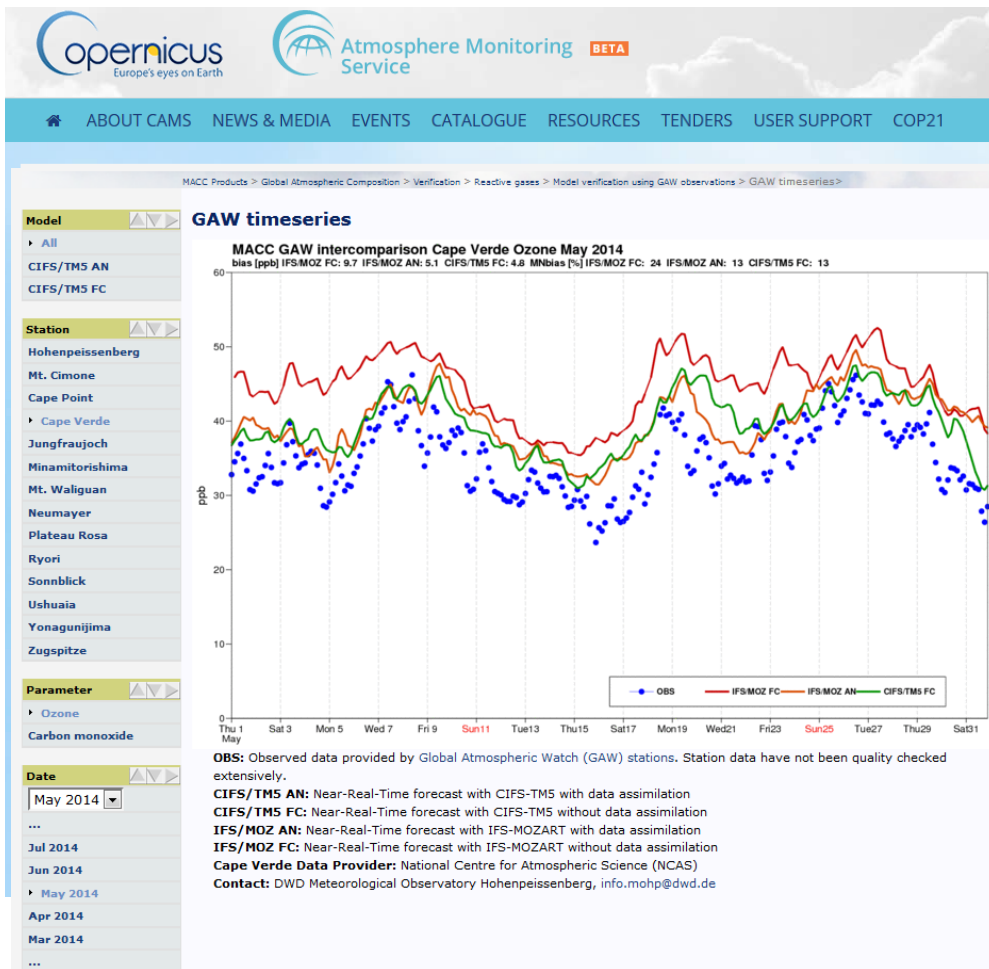


- Is it real or an instrumental artefact? Local knowledge is key to judge.
- Consult logbook entries, compare with other local data (air quality, meteorology)

# Using model output information

[http://gmes-atmosphere.eu/d/services/gac/verif/grg/gaw/gaw\\_station\\_ts/](http://gmes-atmosphere.eu/d/services/gac/verif/grg/gaw/gaw_station_ts/)

or



**WORLD METEOROLOGICAL ORGANIZATION**  
Please visit our public website: <http://public.wmo.int>

## Global Atmosphere Watch (GAW)

### News and Updates

- 24 July 2017: Svalberget and Norunda stations, Sweden, have joined GAW as a Regional station
- 7 June 2017: The Cyprus Atmospheric Observatory (CAO) station, Cyprus has joined GAW as a Regional station (<http://www.cslac.cy/index.php?cat=10>)
- 23 May 2017: The final report from the GAW Workshop on Measurement-Model Fusion for Global Scale Atmospheric Modelling has been published.
- 16 May 2017: The first Reactive Gas Bulletin has been published.
- 21 April 2017: Registration and abstract submission to GOMT 2017 is open at the meeting web page
- 18 April 2017: Materials of the GAW Symposium 2017 are available on the Symposium web page

For more news and for signing up to the e-zine, please go to [NEWS-ARCHIVE](#)

### Strategic Documents

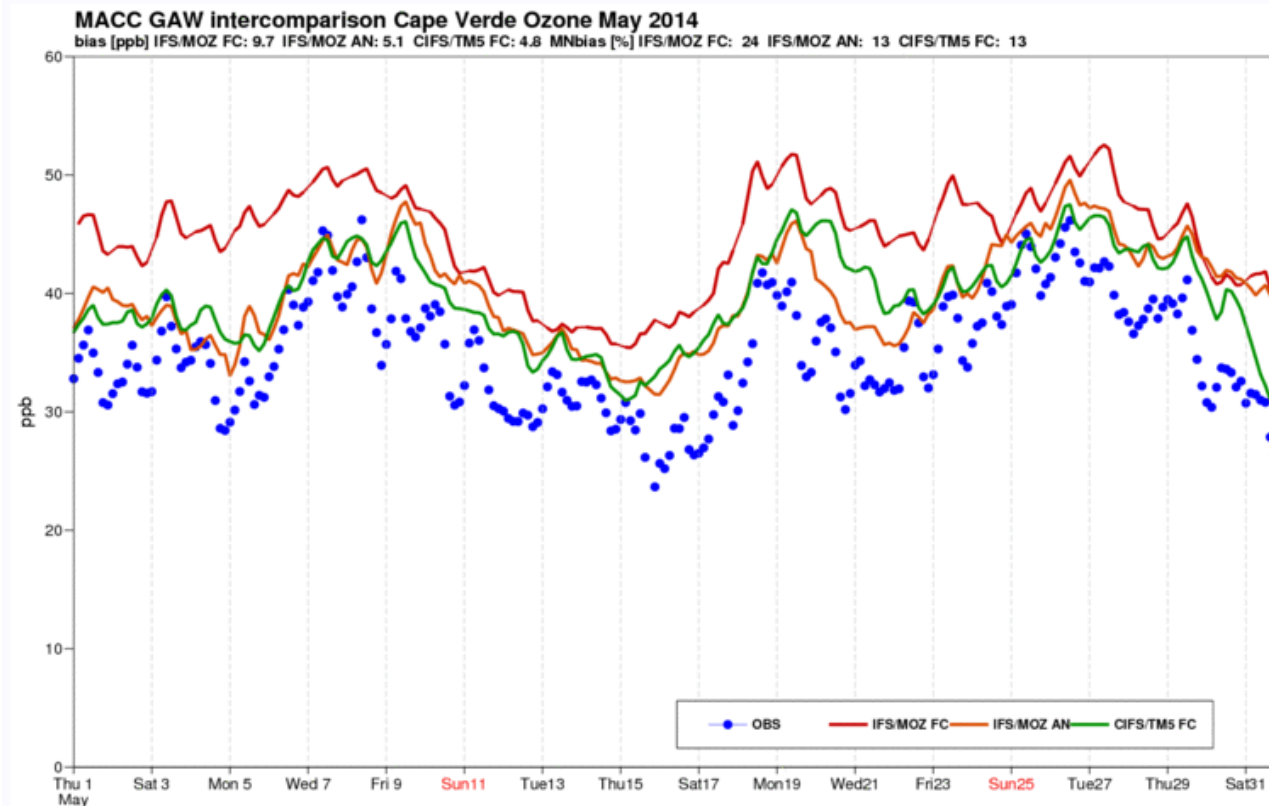
- GAW Implementation Plan (IP)
- Proposal of Global Greenhouse Gas Information

**Right sidebar links:**  
GAW Home  
Observational History  
Commission for Atmospheric Sciences  
Expert Teams  
Scientific Advisory Groups  
Expert Teams  
EDMC SSC  
Observations  
GAW Stations  
GAW Stations  
Information Systems (metadata)  
World Data Centres  
Quality Assurance  
Observatory on WVAOC terms  
GAW local areas  
Academy  
Greenhouse Gases  
Reactive Gases  
Ozone  
UV Radiation  
Precipitation Chemistry  
Modeling Applications  
**Near-Real-Time Model Validation with GAW Data**  
Publications  
GAW reports  
Publications

# Using model output information

[http://gmes-atmosphere.eu/d/services/gac/verif/grg/gaw/gaw\\_station\\_ts/](http://gmes-atmosphere.eu/d/services/gac/verif/grg/gaw/gaw_station_ts/)

## GAW timeseries



**OBS:** Observed data provided by Global Atmospheric Watch (GAW) stations. Station data have not been quality checked extensively.

**CIFS/TM5 AN:** Near-Real-Time forecast with CIFS-TM5 with data assimilation

**CIFS/TM5 FC:** Near-Real-Time forecast with CIFS-TM5 without data assimilation

**IFS/MOZ AN:** Near-Real-Time forecast with IFS-MOZART with data assimilation

**IFS/MOZ FC:** Near-Real-Time forecast with IFS-MOZART without data assimilation

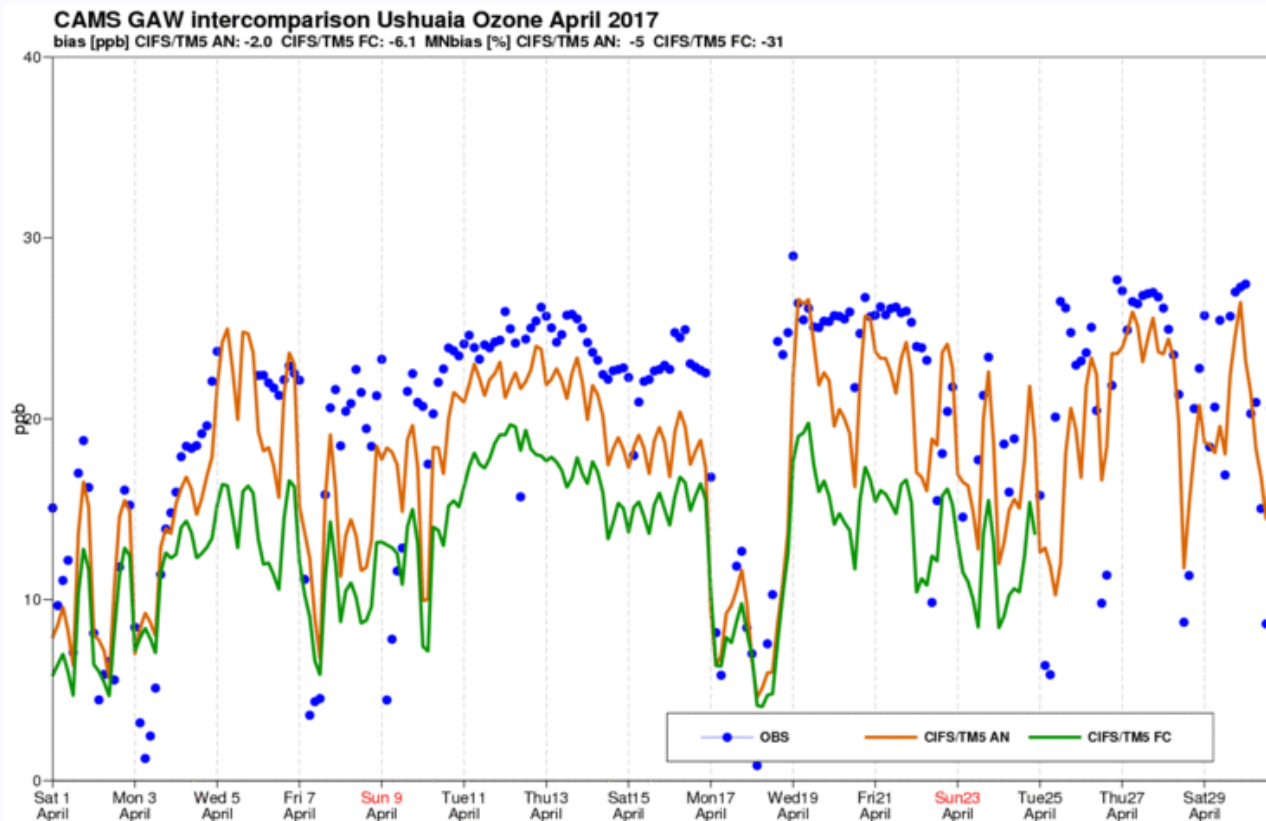
**Cape Verde Data Provider:** National Centre for Atmospheric Science (NCAS)

**Contact:** DWD Meteorological Observatory Hohenpeissenberg, [info.mohp@dwd.de](mailto:info.mohp@dwd.de)

# Using model output information

[http://gmes-atmosphere.eu/d/services/gac/verif/grg/gaw/gaw\\_station\\_ts/](http://gmes-atmosphere.eu/d/services/gac/verif/grg/gaw/gaw_station_ts/)

## GAW timeseries



**OBS:** Observed data provided by Global Atmospheric Watch (GAW) stations. Station data have not been quality checked extensively.

**CIFS/TM5 AN:** Near-Real-Time forecast with CIFS-TM5 with data assimilation

**CIFS/TM5 FC:** Near-Real-Time forecast with CIFS-TM5 without data assimilation

**IFS/MOZ AN:** Near-Real-Time forecast with IFS-MOZART with data assimilation

**IFS/MOZ FC:** Near-Real-Time forecast with IFS-MOZART without data assimilation

**Ushuaia Data Provider:** National Meteorological Service

**Contact:** DWD Meteorological Observatory Hohenpeissenberg, [info.mohp@dwd.de](mailto:info.mohp@dwd.de)

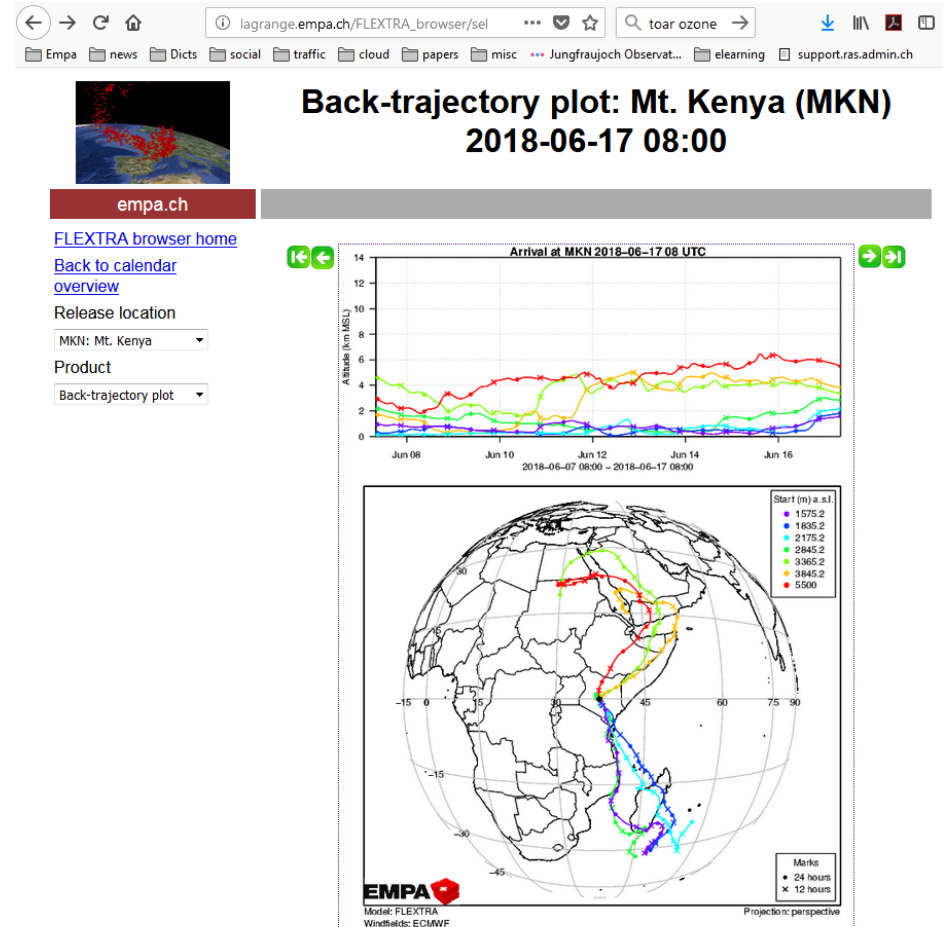
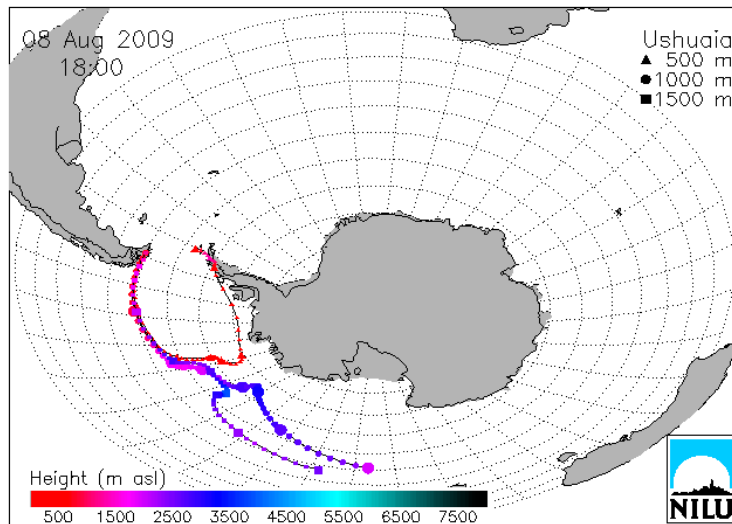
# Using trajectory information

Available through the internet  
from various sources

[http://lagrange.empa.ch/FLEXTRA\\_browser/](http://lagrange.empa.ch/FLEXTRA_browser/)

<http://www.emep.int/trajectories.html>

<http://www.arl.noaa.gov/ready/hysplit4.html>



## Product information:

The back-trajectory plot provides a perspective view of back-trajectories initialized at the given site and followed 10-days backward in time. Different colors indicate different initial altitudes. The upper panel shows the vertical pathway of the air parcels; the bottom panel gives a perspective projection of the horizontal pathways. Thick lines indicate reference trajectories, thin lines (if available) give uncertainty trajectories started in a circle 0.25° around the site. Traveling times along the trajectory are marked by filled circles (24 h) and crosses (12 h). The calculations are based on the [FLEXTRA](#) model and driven by ECMWF windfields with a global resolution of 1° x 1° and 0.2° x 0.2° for the Alpine area (since 2006).



# Questions ?