## **Data Quality at GAW-Stations**



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## **Data Quality at GAW Stations**

- Presentation of UBA project -- 30 min.
- Newer developments and requirements (Geneva 2005) -- 5 min.
- Discussion 10 to15 min.
- Detailed demonstration and discussion in the working group.
- Data Quality working programme A.Mishev.
- Commonly accepted unified model.
- List of priorities what still has to be done.
- Working plan.

#### **Data handling and QA at GAW-Stations**

The international GAW-Programme concentrates on education, standardized measurement, measurement calibration and data collection by world data centres. *However the operational service at GAW measurement stations in form of data collection and handling and the development and application of methods for quality assurance at stations presently is not supported by the GAW programme centrally.* 

Considering this background it is questionable whether most of the GAW station process data by its own including development of software.

Exactly at this point starts the following presentation of a project at the Federal Environmental Agency which finished in march 05. Based on a new software solution it will be discussed if and how other GAW stations can use these programs for data processing and quality control in their own field.

#### **Data Quality at GAW Stations**

Chances for a cooperation in GAW:

>Use tools and experiences of others.

Stay in contact for information.
Perhaps an internet forum would be a first practical solution.

Longer cooperation will result in standardisation.

According to the framework of GAW standardisation has to be done.

For GAW stations: software free of charge can be accessed.

## Data quality hierarchy, role of standards, measurement and data structure



sample, zero, calibr., calibr., sample, sample, sample, ..., sample, zero, calibr.

## Data quality hierarchy production of quality assured data -1-

measure raw data and retrieve.

select time scale, perform calibrations, retrieve data.

recalibrate working standard at beginning and end of use, change working standard when required.

online test for over- and underflow of measured values and device parameters, produce control charts, calculation of raw concentration values (automated QC for internet publ. or satell. groundtruthing !).

if required: adjustment and repair of measurement device.

Input of additional technical data relevant for measurement and calibration to the station log book.

See: production of quality assured data -2-

## Data quality hierarchy production of quality assured data -2-

On the low level time scale with minute data: remove outliers, control raw data values, control instrument parameters, control and censorise calibrations.

Use station log-book data for this control process.

Calculate calibrated data, minute values, half hour mean values.

Evaluation of special episodes: compare with parallel measured time series of other measurement values which are in relation to the actual measurements, compare with synoptical data.

Filtering procedure for flagging local influences.

final product – time series with flagged (half) hour mean values.

## **Data processing at UBA GAW Station**



### DAQAS data access, quality and assurance system

**DB Server and graphical front end,** written completely in Java for user control of all activities and performances of the whole system:

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TEI 42C			NO	0.19	ppb	0.19	ppb	2004-06-19 12:56:30.000	
TEI 42C		iil,	N02	1.95	ppb	1.95	ppb	2004-06-19 12:56:30.000	
TEI 42C		iil,	NOx	2.14	ppb	2.14	ppb	2004-06-19 12:56:30.000	
TEI 48S		iil,	CO	-270.8	ppb	2.86	volt	2004-06-19 12:56:30.000	
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							DB interface version 0.3	.1	
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							DB interface version 0.3	.1	
							DB interface version 0.3	.1	

### **DAQAS**, features



#### DAQAS, Station Book Input of meta data

📋 Station Book	•	c <sup>re</sup>							
		Operator Ries -							
Fentry characte	eristics —								
Start date	2004-0	06-19 Start time 08:00 MEZ							
End date	2004-0	16-19 End time 09:00 MEZ							
Instrument gro	oups Cra	nox-System							
Task list	Task list Martung MathanCC								
	Wartung M	MilliQwasser							
l l	- Wartung N	NOX-TEI42							
l b	Wartung N	Aulluft-Breitfuss							
N N	Wartung N	tulluft-GMC							
Entries									
Instrument/Pa	rameter	CRANOX CLD 1   NO2							
		CRANOX CLD 2 NO							
		CRANOX CLD 2   NOy							
		EDV und Gerätecheck -> i.O.							
Executed task	s	Datensichtung (Vortag/e)							
		Î							
Remarks		System in Ordnung, hei den NO-Werten sehr aute Übereinstimmung mit TE42C							
Date		Entries							
2004 6 40 0 1 of 1 0									
		New Cancel Save Close							

#### DAQAS, retrieve of data



### DAQAS

The **Client** shows all user relevant output from the control program and all other user relevant input to the other part of the station data quality system as there are: Station Book, Backup System, Isave Program for data evaluation and quality control, Report Generator and Help functions. In normal operation mode during operational real time measurement the first Window upper left is the main control panel which always is opened. It shows all active measurement devices, the measured gases, their one minute average values of automatically calculated concentrations and their raw values and the measurement units. In case the user wants to see a graphical display of measured time series and occasionally a list of all measurement parameters which have been measured parallel an additional list with all measurement parameters can be opened; - see table at lower right. In case some under- or overflow of values happens a signaling window opens with a short memo. Additionally al list of protocols of interactions of the system can be displayed and controlled by the instrument Control Program & Database server for data retrieval, instrument control and online quality assurance support. This java program controls the ADAM process computer system for analog retrieval of data and control of automated calibration and zero air control via relays and magnetic valves. It performs digital data retrieval presently from all Thermo Environmental system instruments.

## DAQAS

It is responsible for database input and online quality control procedures as over- and underflow control of measured values and instrument parameters, automatic calibration calculation and control cards for example. These concentration levels are determined for operational purposes in order to enable the measurement crew for right in time corrections of measurements under operation. Furthermore this database and measurement control program contains methods for automated quality assurance as control cards and signalling override or underflow of threshold values. Database for RAW data on order to contain raw data and related instrument parameters as also automatic calibration results in order to give the measurement staff in advance control possibilities about actually measured concentration levels. The database was realised in the SAP-DB database system which is available for free via internet.

**Database for Meta data**, also called station book or log book for input of all practical activities at the measurement station which can affect measurements and data quality. Each note in this station book consists of a date and time for start and a duration and an index for measurement instrument and measured effect and additional free text. In order to receive more information please read the present version of the handbook, written in english

## ISAVE integrated control system for statistical quality assurance



## **ISAVE**, instruction

- 1. Open **graphical editor**, select a combination of measurement variable and measurement device.
- 2. Select the time range.
- 3. Fetch data from the data base with the actualize button (spiral circle symbol)
- 4. Control all measurements also calibrations for outliers. When required, set values to missing data with the envelope curve editor.
- 5. Activate the window **calibrations**. Select measurement variable and time range.
- 6. Read data with actualize button.
- 7. In case your time series have a relatively strong zero drift for example when CO data will be measured with TE 48 instruments and zero, sample, zero, sample will be measured alternating in the next step the button with "calibraton for CO" will have to be activated.
- 8. Perform the calculation of quality assured and calibrated half hour mean values with the button "calibration".

#### **ISAVE:** select variable and read data



# ISAVE enlarge a time window and use graphical editor



## ISAVE, after editing, select time range, actualize and calibrate

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<b>n</b>										
Parameter & instrument: CO/TEI 48C 🔹 from: 19.01.2005 🛐 to: 31.01.2005 🛐										
Calibration Script Linear calibration of CO gas Eslect calibration types										
Selection Chart 30 min values Mean values										
	Measurements				Standards				Callibration values:	
Date time	Concentration	Raw value	^	Date time	Concentration	Raw value	Gas description	^	from: 19.01.2005 15	
19.01.2005 00:00:40	124.980	122.375		20.01.2005 15:22:5	0.000	6.621	Samplenullluft (gescrubbert?)			
19.01.2005 00:01:40	147.596	143.675		20.01.2005 15:23:5	0.000	9.821	Samplenullluft (gescrubbert?)		to: 31.01.2005 🔟	
19.01.2005 00:02:40	135.651	132.425		20.01.2005 15:24:5	0.000	-17.579	Samplenullluft (gescrubbert?)		Road data	
19.01.2005 00:03:40	127.263	124.525		20.01.2005 15:25:5	0.000	-8.679	Samplenullluft (gescrubbert?)			
19.01.2005 00:04:40	128.271	125.475		20.01.2005 15:26:5	0.000	12.121	Samplenullluft (gescrubbert?)			
19.01.2005 00:23:50	138.571	135.175		20.01.2005 15:27:5	0.000	-6.429	Samplenullluft (gescrubbert?)		Calibration	
19.01.2005 00:24:50	140.748	137.225		20.01.2005 15:28:5	0.000	6.621	Samplenullluft (gescrubbert?)		<ul> <li>Linear</li> </ul>	
19.01.2005 00:25:50	135.439	132.225		20.01.2005 15:29:5	0.000	-16.679	Samplenullluft (gescrubbert?)			
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19.01.2005 00:27:50	169.097	163.925		20.01.2005 15:32:0	0.000	5.921	Samplenullluft (gescrubbert?)			
19.01.2005 00:28:50	144.251	140.525		20.01.2005 15:33:0	0.000	-7.979	Samplenullluft (gescrubbert?)			
19.01.2005 00:29:50	143.880	140.175		20.01.2005 15:34:0		16.671	Samplenullluft (gescrubbert?)			
19.01.2005 00:30:50	113.672	111.725		20.01.2005 16:00:0	525.100	466.347	Samplenullluft (gescrubbert?)			
19.01.2005 00:31:50	136.500	133.225		20.01.2005 16:01:0	525.100	476.847	Samplenullluft (gescrubbert?)		Delete selected row	
19.01.2005 00:32:50	131.616	128.625		20.01.2005 16:02:0	525.100	479.397	Samplenullluft (gescrubbert?)			
19.01.2005 00:52:50	116.978	114.838		20.01.2005 16:03:0	525.100	478.497	Samplenullluft (gescrubbert?)			
19.01.2005 00:53:50	133.223	130.138		20.01.2005 16:04:0	525.100	475.997	Samplenullluft (gescrubbert?)			
19.01.2005 00:54:50	133.966	130.838		20.01.2005 16:05:0	525.100	483.647	Samplenullluft (gescrubbert?)			
19.01.2005 00:55:50 129.560 126.688			20.01.2005 16:06:0	525.100	479.497	Samplenullluft (gescrubbert?)				
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	18561 records	;						11		

### **ISAVE**, 30min mean for export

METEORA



### **Software Matrix**

Name	Purpose	Functions
DAQAS	Data aquisition, automatic instrument calibration, automated and person controlled QC	Graphs and tables of raw values and instrument parameters, control cards, filling raw data base, station book
ISAVE	Calibration of GAW timeseries data, link to DAQAS raw data base and station book DB, interactive removal of outlier and calculation of cali- brations, intermediate results to DB	Import of external data, Interactive removal of outlier, censorisation, calibration, programmable, output-> 1/2h mean values
REPGEN	Fast access to daily, monthly, yearly data, drawing time series basic statistic parameters, mean daily variation	Input: tables of 1/2h mean values. Export: Graphs, files of selected measurement variables via the time
FILTER	Filtering local influences after adjustment of the filter procedure to the requirements of the station	Input: <sup>1</sup> / <sub>2</sub> h mean value files of ISAVE. Output: flagged <sup>1</sup> / <sub>2</sub> h mean files

### **Software -- usability Matrix**

Name	Operating system	State of use, language	Documents and interface	Require- ments	Availability
DAQAS	Windows XP, Linux	Java, since 2/03 in continous use	english	PentiumIV, SQL DB (GPL)	UBA: non exclusive license
ISAVE	Win 98, NT, XP	Delphi, since 05/04 in use	english	Pentium IV or smaller, SQL DB, (GPL)	UBA: non exclusive license
REPGEN	Win 98 NT, XP	Visual Basic, in use since 98	English in preparation	Pentium I upwards	OK
FILTER	Win 98, NT, XP	MS Access, since 2001 in use	german	Office, Access, Pentium II upwards	OK

#### **Data Quality at GAW Stations**

### Links

#### Homepage

http://gawdataeval.tripod.com/

-- presently the site going to be changed to

http://gawdataeval.com/

Filter ( in German) http://www.icara.de/geo/gawfilt.htm

On CD and homepage you will find an english pdf with project description

Forum for GAW Station Members

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unter- Summary

ein

kt Retrieval of Data and System Control

> Data Evaluation and Quality Assurance

Software Project of

the Federal

Environmental

Agency Germany

State of the Project

Filtering of local Influences Future Developments

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