Brewer configuration and data processing

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EUBREWNET Training School 2016

1 Brewer configuration files

2 Configuration in EUBREWNET

3 Data upload and levels architecture of EUBREWNET

4 Accessing EUBREWNET products

Brewer configuration files

- B-files are the most complete files were the Brewer data are saved
- D-files are human-readable files
- in recent releases of the Brewer operating software, the content of several small configuration files are copied into the B-file header (just *copied*, if you want to change something you must modify the single config files or use the `cf`, `ic` or `ll` routines)
- configuration is partly duty of the Brewer operator and partly in charge of the calibration service provider

Choose a recent B-file `Bdddyy.nnn` from your data series and open it with an ASCII editor.

e.g., `http://bit.ly/2c4x3ST`

Brewer configuration files

Data header

Each B file begins with a data header.

Example	Name
Version=2	B file version number
Dh	Header
25	Day
11	Month
98	Year
Saskatoon	location name
52.108	latitude
106.713	Longitude
3.45	Temperature in volts
Pr	Pressure header
1000	Mean Pressure

← date in filename and header can differ!

← West positive

Temperature, in volts (TE%) - Read from the PMT thermistor. The temperature in °C is calculated using the equation: $Temp(C) = -33.27 + TE\% \times 18.64$

If you want to change location (e.g., during a campaign), please modify file OP_ST.nnn (can you find it on your PC?)

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Brewer configuration files

Data header

Then you can have some comment blocks (variables and values used by the software) depending on the version of the operating software...

```
co
23:49:43
dh: day header
co
23:49:43
main: version 4.10
07/04/2015 15:00:00
co
23:49:43
skc: aoo3zs
co
23:49:43
autohg:  0
co
23:49:43
hifw2:  0
co
23:49:43
attn:  25000  80000
co
23:49:43
lowds:  1
```

Brewer configuration files

Instruments constants

ICFJJJYY.NNN - INSTRUMENT CONSTANTS

The operating state file controls many of the operating parameters of the Brewer. The left column lists the actual value written in the OP_ST.nnn file. The middle column is the BASIC variable name used in the Brewer software to contain this value, and the right column is a description of the value's meaning.

← this is a copy of the `ICFdddyy.nnn` file provided by the calibration service

#	Example	Name
1	0	Ozone temperature coefficient for slit 1
2	-.3428	Ozone temperature coefficient for slit 2
3	-.6509	Ozone temperature coefficient for slit 3
4	-1.3636	Ozone temperature coefficient for slit 4
5	-2.4043	Ozone temperature coefficient for slit 5
6	.1	Micrometer steps per degree
7	.3407	Ozone on ozone ratio
8	2.35	SO_2 on SO_2 ratio
9	1.1417	Ozone on SO_2 ratio
10	2187	ETC on ozone ratio
11	3340	ETC on SO_2 ratio
12	.000000042	Dead time (seconds)
13	286	Wavelength calibration step number
14	14	Slit mask motor delay
15	1685	Umkehr offset
16	0	Neutral density of filter 0 (divide by 10^4 to get attenuation)
17	4440	Neutral density of filter 1 (divide by 10^4 to get attenuation)
18	10320	Neutral density of filter 2 (divide by 10^4 to get attenuation)
19	14120	Neutral density of filter 3 (divide by 10^4 to get attenuation)
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22	2972	Zenith motor steps per revolution
23	mkiv	Brewer model type
24	1	COM port number

← TC from SL series

← depends on wavelengths (diff.abs.coeff.)

← nominally set

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← your ETCs from calibration

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Example

$$O_3 = \frac{MS_9 - 2187}{0.3407 \cdot \mu}$$

MS_9 is the linear combination of *corrected* countrates using the ozone coefficients (double ratio)

μ is the airmass factor

O_3 must be divided by 10 to get value in DU

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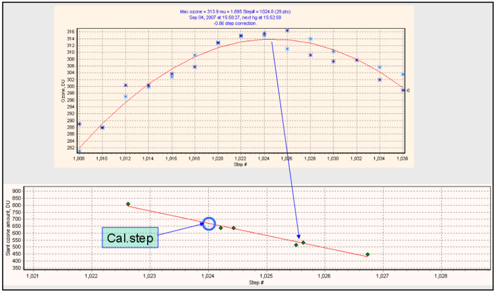
SC test

- search for zero ozone sensitivity for slight wavelengths misalignments
- shape comes from Fraunhofer lines and ozone X-secs
- therefore it represents an absolute wavelengths reference available everywhere



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15	1685	Umkehr offset ← Umkehr has 5 wavelengths more
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you need spectral for AOD

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← Umkehr has 5 wavelengths more

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27	0	NO_2 temperature coefficient for slit 1
28	0	NO_2 temperature coefficient for slit 2
29	0	NO_2 temperature coefficient for slit 3
30	0	NO_2 temperature coefficient for slit 4
31	0	NO_2 temperature coefficient for slit 5
32	1	ozone micrometer offset
33	0	Not used.
34	242	Ozone filter wheel #3 position
35	-3	NO_2 absorption coefficient
36	765	NO_2 direct sun ETC
37	740	NO_2 zenith sky ETC
38	2511	NO_2 micrometer offset
39	178	NO_2 filter wheel #3 position
40	2510	Ozone/ NO_2 mode change distance for micrometer
41	0	Not used.
42	0	Not used.
43	2669	Micrometer zero position
44	250	number of motor steps to open iris

MkIV Brewers

← don't trust them!

← origin of wl scale for UV scans

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45	.2	Computer buffer delay (larger numbers for faster computers)
46	64	NO_2 filter wheel #1 position
47	256	Ozone filterwheel #1 position
48	0	Filterwheel #2 position
49	64	UV filterwheel #2 position
50	0	Steps from zenith sensor to the hard stop
51	2232	Zenith UV position ← useful to align prism to UV port
52	June 1/99	Release Date ← when was your Brewer calibrated last time?

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Dispersion constants

DCFJJJ.NNN - DISPERSION CONSTANTS

#	Example	Name
1	2841.969	intercept for slit 1
2	0.07708953	slope for slit 1
3	-7.53908e-07	quadratic for slit 1
4	2881.748	intercept for slit 2
5	0.07640633	slope for slit 2
6	-7.774226e-07	quadratic for slit 2
7	2918.904	intercept for slit 3
8	0.07555325	slope for slit 3
9	-7.810584e-07	quadratic for slit 3
10	2954.205	intercept for slit 4
11	0.07485946	slope for slit 4
12	-8.023931e-07	quadratic for slit 4
13	2990.217	intercept for slit 5
14	0.0732299	slope for slit 5
15	-7.105979e-07	quadratic for slit 5
16	2808.557	intercept for mercury exit slit
17	0.07786144	slope for mercury exit slit
18	-7.580347e-07	quadratic for mercury exit slit
19	4262.953	NO_2 intercept for slit 1
20	0.1156343	NO_2 slope for slit 1
21	-1.130862e-06	NO_2 quadratic for slit 1
22	4322.622	NO_2 intercept for slit 2
23	0.1146095	NO_2 slope for slit 2
24	-1.166134e-06	NO_2 quadratic for slit 2
25	4378.356	NO_2 intercept for slit 3
26	0.1133299	NO_2 slope for slit 3
27	-1.171588e-06	NO_2 quadratic for slit 3
28	4431.307	NO_2 intercept for slit 4
29	0.1122892	NO_2 slope for slit 4
30	-1.20359e-06	NO_2 quadratic for slit 4
31	4485.325	NO_2 intercept for slit 5
32	0.1098448	NO_2 slope for slit 5
33	-1.065897e-06	NO_2 quadratic for slit 5
34	4212.835	NO_2 intercept for mercury exit slit
35	0.1167922	NO_2 slope for mercury exit slit
36	-1.137052e-06	NO_2 quadratic for mercury exit slit

← this is a copy of the `DCFdddyy.nnn` file

3 x 6 x 2 coefficients

- 3 = 2^{nd} degree polynomial
- 6 = number of slits
- 2 = modes (O_3 and NO_2)

Dispersion relation (wavelength vs motor steps) is retrieved by fitting know wavelengths of emission lines from several lamps to the peaks positions (microstep) measured by the Brewer

Brewer configuration files

Zenith sky constants

ZSFJJJYY.NNN (ZSFVAL)- ZENITH SKY CONSTANTS

Zenith Sky constants are used in the ZS ozone calculations, and are Location/Brewer dependent. They are derived by making a comparison of near simultaneous DS and ZS measurements over a wide range of mu and ozone values (usually many months).
The values supplied in ZSFVAL.nnn are for a Brewer #035 operating in Toronto, Canada, and should produce results which are accurate to within 5% or so. These values can be used until a new set can be derived for the new site.

Example	Name
-0.006400	Coefficient #1
-0.019680	Coefficient #2
0.016540	Coefficient #3
0.123076	Coefficient #4
0.281095	Coefficient #5
-0.060974	Coefficient #6
-0.486491	Coefficient #7
0.458119	Coefficient #8
-0.044107	Coefficient #9

← this is a copy of the `ZSFdddyy.nnn` file

9 empirical coefficients:

$$F - F_0 = a + b\mu + c\mu^2 + dX + eX\mu + fX\mu^2 + gX^2 + hX^2\mu + kX^2\mu^2$$

See my poster at QOS for a different formulation

Brewer configuration files

Operating state file

OP_ST.NNN - OPERATING STATE FILE

The operating state file controls many of the operating parameters of the Brewer. The left column lists the actual value written in the OP_ST.nnn file. The middle column is the BASIC variable name used in the Brewer software to contain this value, and the right column is a description of the value's meaning.

	Sample	SW Variable	Explanation
1	162	NO$	Brewer ID number
2	C:\bdata\	DD$	Data Directory
3	icf25899	ICF$	instrument constants file
4	zsf32098	ZSF$	zenith sky coefficients file
5	dcf14799	DCF$	dispersion constants file
6	uvr09899	UVR$	UV response file
7	18	DA$	month Brewer was last in operation
8	09	MO$	Month Brewer was last in operation
9	99	YE$	Year Brewer was last in operation
10	Saskatoon	LO$	Location of Brewer instrument
11	52.108	L1$	Latitude of instrument
12	106.713	L2$	Longitude of instrument
13	960	L3$	Average climatic station pressure (millibars)
14	3.54	TE$	Voltage representation of Brewer temperature
15	810	NC%	Azimuth north correction
16	-12	HC%	Zenith horizon correction
17	14666	SR%	Azimuth steps per revolution
18	1	Q1%	Zenith drive motor
19	1	Q2%	Azimuth drive motor
20	1	Q3%	Iris drive motor
21	1	Q4%	Filterwheel #1 drive motor
22	1	Q5%	Filterwheel #2 drive motor
23	0	Q6%	Clock board

← from sighting (SI) test

← from SR test

YES/NO

Brewer configuration files

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← from SR test

YES/NO

Brewer configuration files

Operating state file

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23	0	Q6%	Clock board

← from sighting (SI) test

← from SR test

YES/NO

24	1	Q7%	A/D board
25	1	Q8%	UVB port
26	1	Q9%	Filterwheel #3 drive motor
27	1	Q10%	New or old temperature circuit. Set to 1 for a new temperature circuit and 0 for an old circuit.
28	0	Q11%	Second film polarizer
29	0	Q12%	Set to 1 to enable NOBREW operation
30	0	Q13%	Wide HG slit present. Always set this to 1.
31	0	Q14%	New Brewer electronics board
32	0	Q15%	Humidity Sensor
33	Skc	DI$	Schedule or menu indicator
34	o3	MDD$	Mode
35	Skd1	SK$	Schedule name

UVRJJJYY.NNN

First column: wavelength in Angstrom.
Second column is responsivity in counts/mW/m^2/nm.

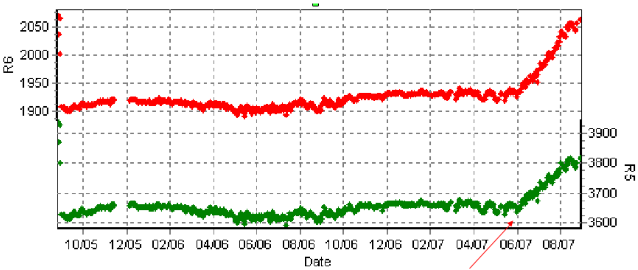
This is a copy of the `UVRdddyy.nnn` file

Brewer configuration files

Operating schedule

```
schedule
-180
pdn2fmfmfmfmfmfmpf99
-110
pdo3aphgslslsln2slslsldtrso3pf
-94
pdo3apzszpzszpzszpzszpzszpzszppf99
-80
pdo3apdszszpdszszpdszszpdszszpdszszpb1uvhgpf99
-60
pdo3apdszszpdszszpdszszpdszszpdszszppf99
-35
pdo3apdszszpdszszpdszszpdszszpdszszpb1uvhgpf99
35
pdo3apdszszpdszszpdszszpdszszpdszszppf99
60
pdo3apdszszpdszszpdszszpdszszpdszszpb1uvhgpf99
80
pdo3apzszpzszpzszpzszpzszpzszppf99
94
pdo3appzzehgn2fmfmfmfmfmfmpf
110
pdn2fmfmfmfmfmfmpf99
180
aoo3zs
```

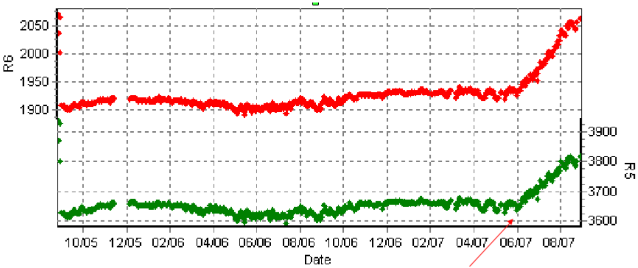
It is enough? No, we still need an estimate of the SL ratios at the time of calibration, so that variations of the ETC can be tracked



$$R6 - R6_{cal} = ETC - ETC_{cal}$$

(N.B. differences are ratios in log space!)

SL ratios at the time of calibration are reported in the calibration certificate



$$R6 - R6_{cal} = ETC - ETC_{cal}$$

R6 and R5 are noisy... Some kind of moving average must be used to track only real ETC changes

1 Brewer configuration files

2 Configuration in EUBREWNET

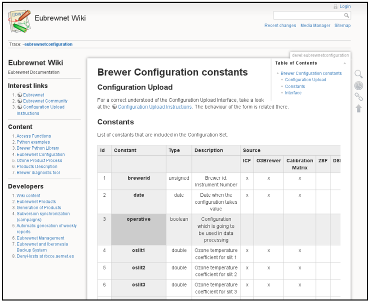
3 Data upload and levels architecture of EUBREWNET

4 Accessing EUBREWNET products

Configuration in EUBREWNET

All relevant variables for each Brewer are saved in EUBREWNET database (192 variables!).

EUBREWNET supports **version control** (history of changes)



Id	Constant	Type	Description	Source				
				ICF	O3Brewer	Calibration Matrix	ZSF	DSI
1	brewerid	unsigned	Brewer id: Instrument Number	x	x	x		
2	date	date	Date when the configuration takes value	x	x	x		
3	operative	boolean	Configuration which is going to be used in data processing					
4	oslit1	double	Ozone temperature coefficient for slit 1	x	x	x		
5	oslit2	double	Ozone temperature coefficient for slit 2	x	x	x		
6	oslit3	double	Ozone temperature coefficient for slit 3	x	x	x		

`http://rbcce.aemet.es/dokuwiki/doku.php?id=devel:eubrewnetconfiguration`

How to upload them to EUBREWNET?

Configuration in EUBREWNET

1. ICF files are automatically uploaded if they are in the folder selected for data sending by the client software
2. Alternatively, you can manually upload the file (ICF or O3Brewer) from your local PC or fill a form with the necessary data by hand
3. **Reference R5 and R6 (at time of calibration) have to be written by hand**

Configuration in EUBREWNET

Available configurations

Brewerid	Date	New	Modify	Download
66	2016-09-01	Add new Configuration	Modify Configuration	Download Configs

Available OZONE Configurations

2006-07-10 2007-04-23 2009-07-09 2010-10-27 2011-08-03 2012-08-01 2013-05-30

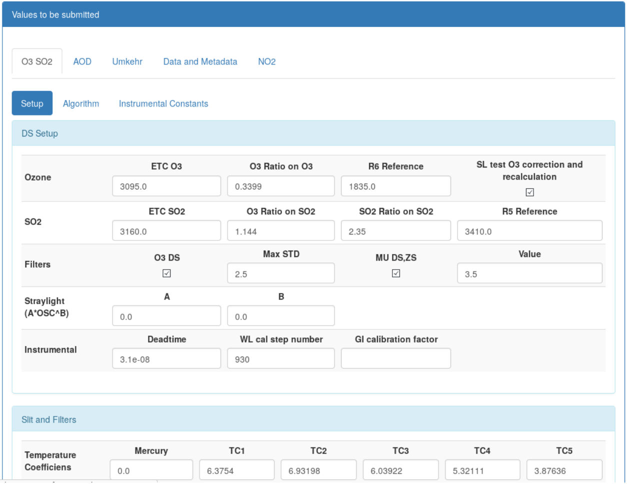
2015-07-17

Field	Value
date	2015-07-17
version	1.0
operator	hdiemoz
modify_date	2016-02-25 08:41:56
id	970
comments	None

`http://rbcce.aemet.es/eubrewnet/configuration/list/OZONE`

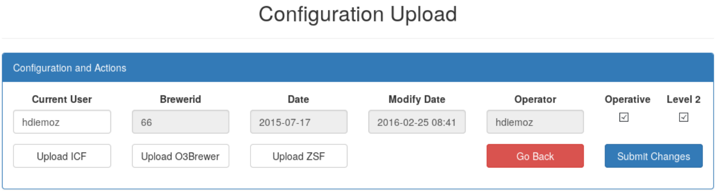
If you have no user, try with azores (pw `azowork`)

Configuration in EUBREWNET



http://rbcce.aemet.es/eubrewnet/configuration/upgrade/OZONE?Brewer=66&Date=2015-07-17&Mod=1

Configuration in EUBREWNET



Remember to submit changes!

It the “SL test O3 correction and recalculation” flag is set, then all data in between two configuration dates will be reprocessed!

Check you config history:
`http://rbcce.aemet.es/eubrewnet/configuration/history`

1 Brewer configuration files

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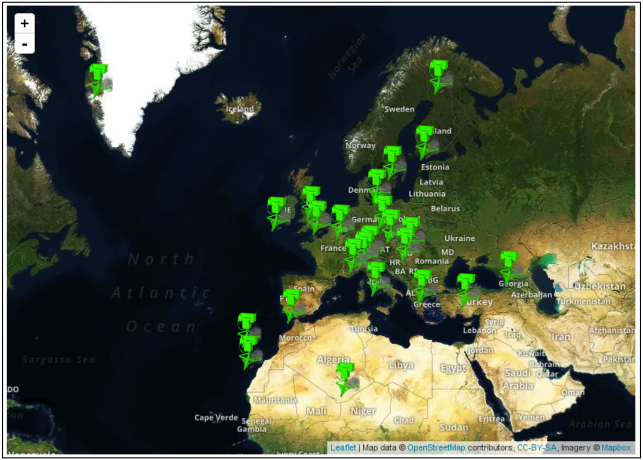
Data upload, data processing and levels architecture of EUBREWNET

EUBREWNET! How does it work?



Data upload and levels architecture of EUBREWNET

The Python client software sends all files to the EUBREWNET server

```
henri@virtBrewer:~/Programmi/eubrewnet/client_python/source$ ls
alive.py    configure.py  log.py   refreshdb.py   refresh.py  util.pyc        xmlrpcproxy.pyc
client.ini  download.py   log.pyc  refreshdb.pyc  util.py     xmlrpcproxy.py
henri@virtBrewer:~/Programmi/eubrewnet/client_python/source$
```

Example of entry in crontab:

```
*/15 * * * * cd /home/henri/Programmi/eubrewnet/client_python/source && python refresh.py >/dev/null 2>&1
```

Data upload and levels architecture of EUBREWNET

Up to now, raw data are processed following the classical Brewer algorithm (Tomi's presentation).

The raw data and the results are organised using quality levels:

Level 0

O_3 and SO_2 coming from the direct sun measures from the Brewer

- values for O_3 and SO_2 extracted from the parsed B files without processing
- the constants used in the process come from the B-file inst section

Data upload and levels architecture of EUBREWNET

Level 1

O_3 and SO_2 recalculations with the standard algorithm from the direct sun measures **and applying a set of constants verified by an operator**

- the calculations use a EUBREWNET module implementing the standard algorithm
- the configuration constants and values used in the process come from the configurations uploaded to EUBREWNET and validated by the operators
- only latitude, longitude and pressure are taken from the inst section of B-files

Data upload and levels architecture of EUBREWNET

Level 1.5 REALTIME OBSERVATIONS

They are Level 1.0 observations with filters and corrections.

Filters:

- ozone standard deviation during a measurement (thresholds set in config, default std: 2.5 DU)
- ozone slant column / air mass (set in config, default airmass: 3.5)
- measurements must have valid hg (step change lees than 2) before and after
- minimum value: 100 DU
- maximum value: 500 DU

Corrections:

- standard lamp correction
- filter correction: ETC filter dependent correction (has to be provided in config)
- stray light correction (two parameters have to be set in config)

Data upload and levels architecture of EUBREWNET

Level 2

Observations validated with a posterior calibration. Only with a subsequent calibration/comparison the ETC correction based on the standard lamp can be validated.

The Level 2 data are produced when the operator activates the verification flag and validates (assign to level 2) the observations data between the current calibration and the previous verified one.

1 Brewer configuration files

2 Configuration in EUBREWNET

3 Data upload and levels architecture of EUBREWNET

4 Accessing EUBREWNET products

You can choose your favourite method to download ozone, UV or AOD products from EUBREWNET:

1. as text or zip files (daily, monthly or yearly product) from each Brewer page
   - e.g., `http://rbcce.aemet.es/eubrewnet/brewer/view/66`
2. with a browser (or any script accessing the Internet) using access functions
   - e.g., `http://rbcce.aemet.es/eubrewnet/data/get/DS?brewerid=157&date=2015-01-01`
3. using Python and the `brewerjson` module
   - more info at `http://rbcce.aemet.es/dokuwiki/doku.php?id=devel:brewerpythonmodule`