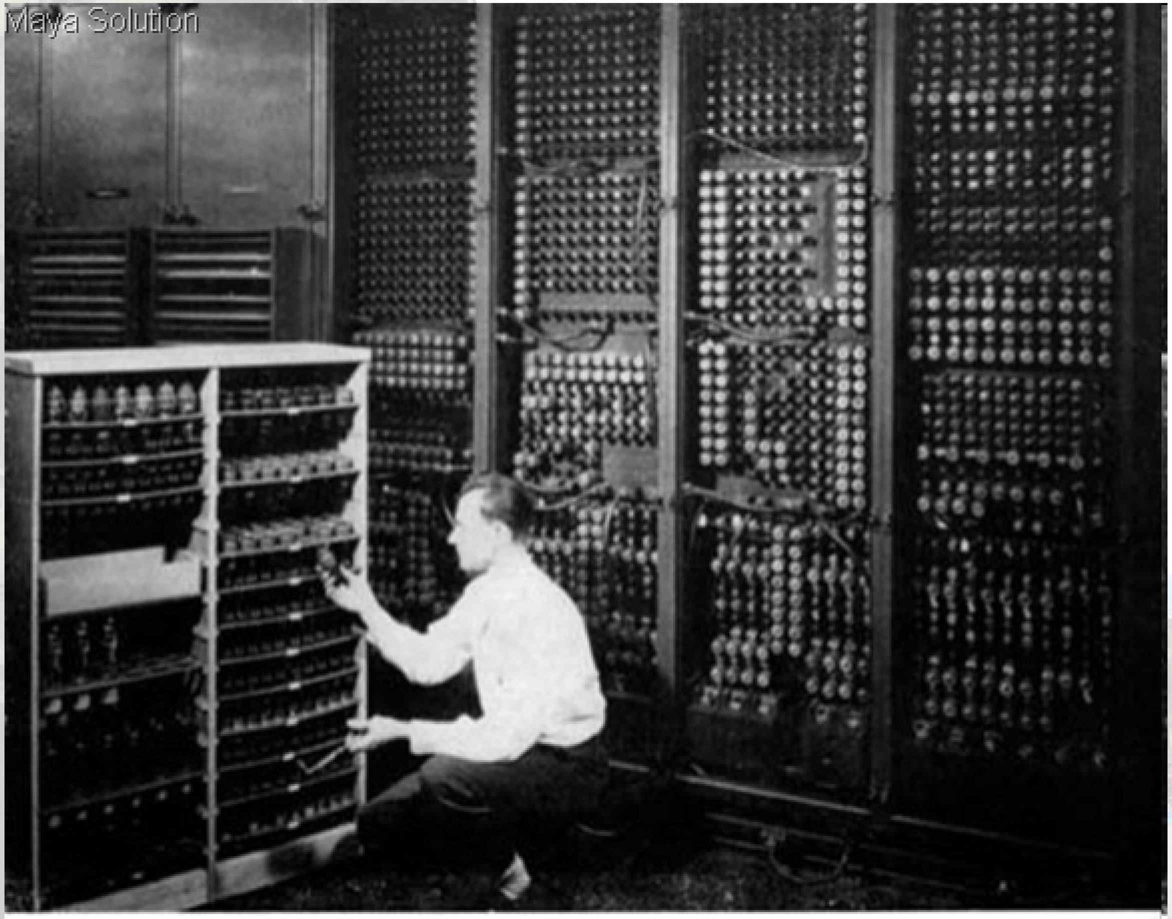
A database implementation of data analysis and quality control for the Brewer



Replacing a bad tube meant checking among ENIAC's 19,000 possibilities.

Volodya Savastiouk

September 22, 2009

12th Brewer Workshop

Valle d'Aosta, Italia

The goals

Diagnostics

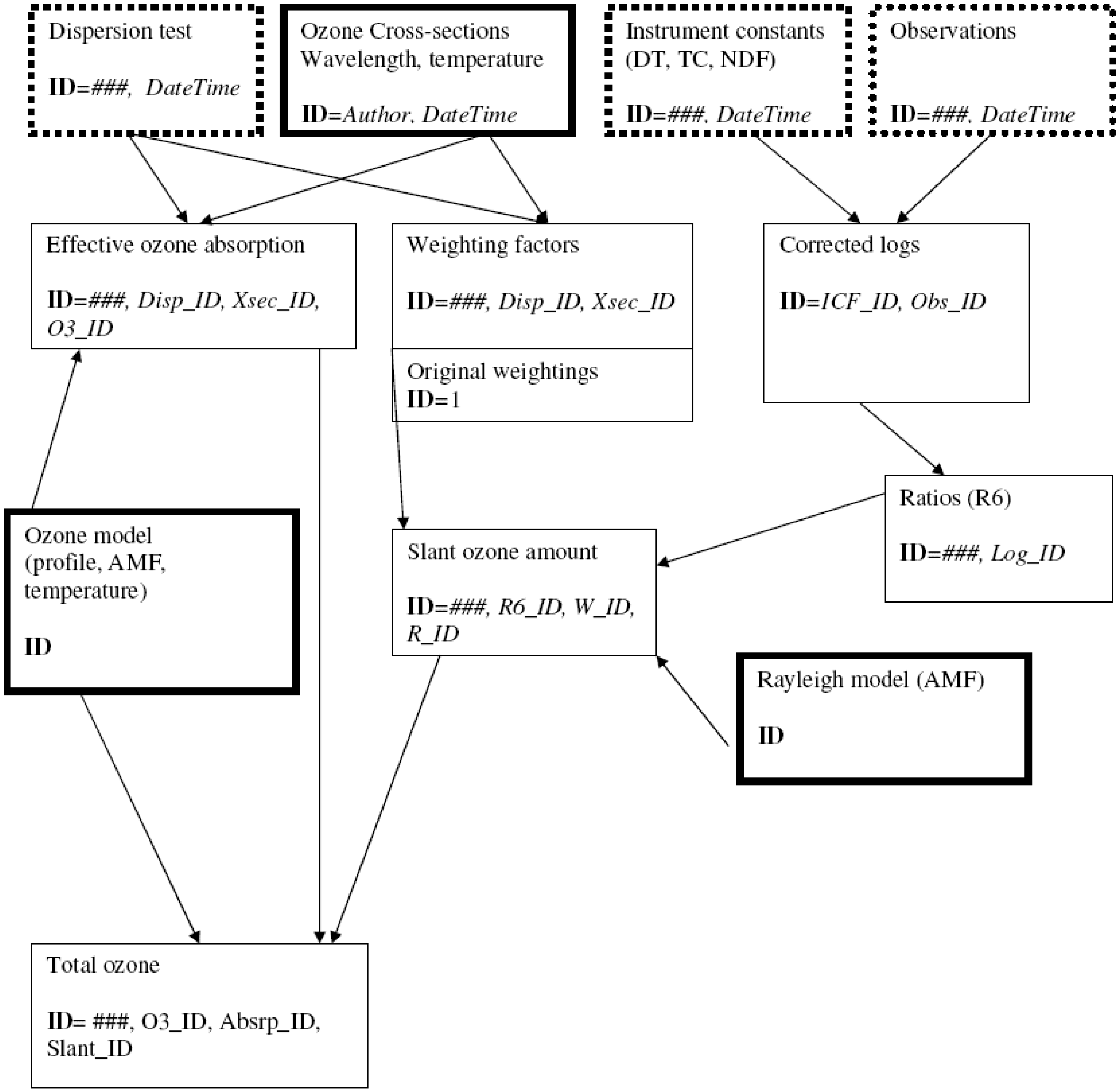
- How can we tell that a Brewer is OK?
  - SL, DT, RS, HP, HG (UV?, DS?,…)

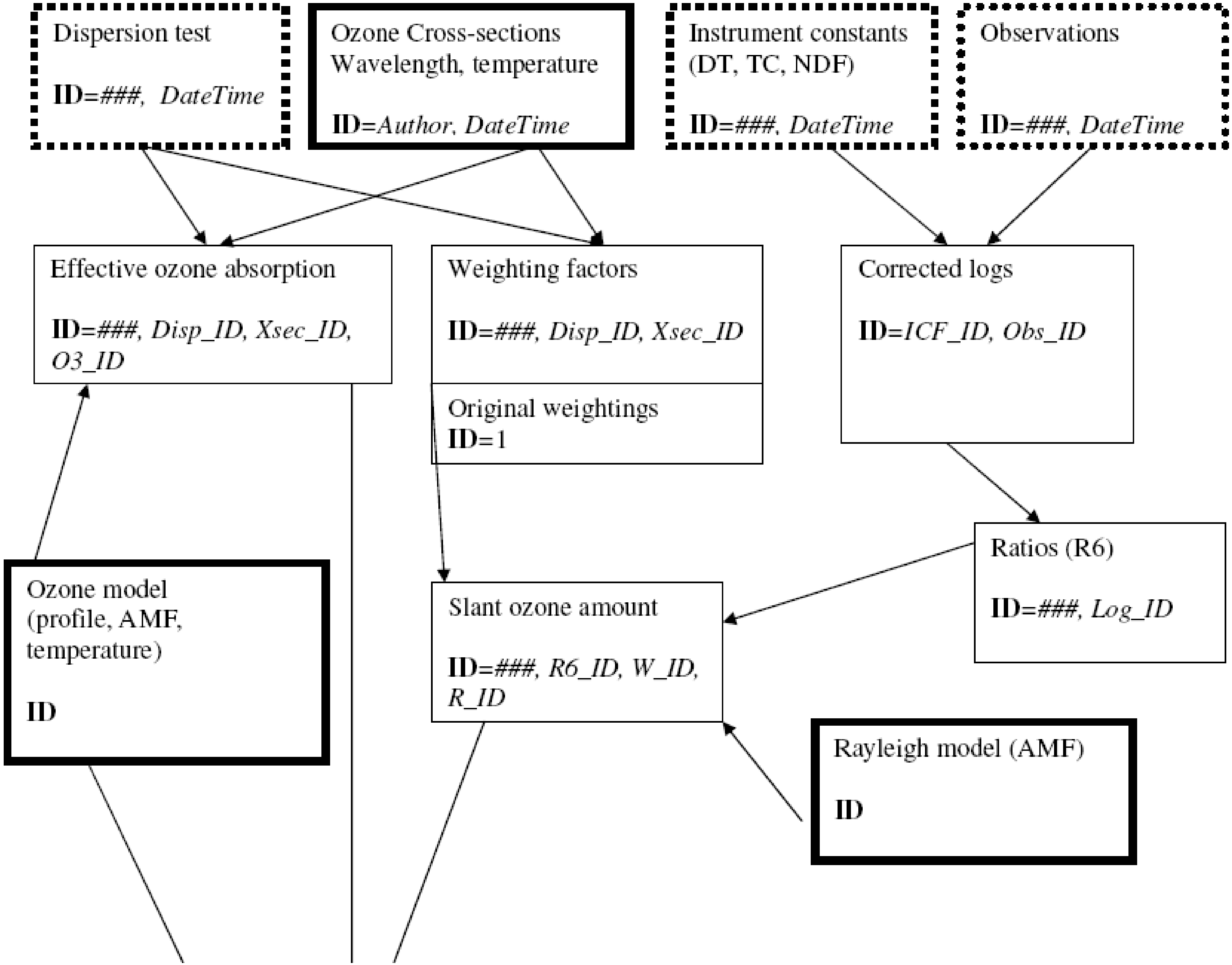
- Can we do diagnostics without additional software? *Yes, but:*
  - Difficulty with looking for historic data
  - Decision-making is primarily subjective
  - Time consuming when dealing with many Brewers

Ozone calculations

- Reprocessing starting as far back as possible
  - Dispersion tests
  - Calibration data (co-located Brewers)

- Tracking the data versions


Dispersion test
ID=###, DateTime
Ozone Cross-sections
Wavelength, temperature
ID=Author, DateTime
Instrument constants
(DT, TC, NDF)
ID=###, DateTime
Observations
ID=###, DateTime
Effective ozone absorption
ID=###, Disp_ID, Xsec_ID, O3_ID
Weighting factors
ID=###, Disp_ID, Xsec_ID
Original weightings
ID=1
Corrected logs
ID=ICF_ID, Obs_ID
Ratios (R6)
ID=###, Log_ID
Ozone model
(profile, AMF, temperature)
ID
Slant ozone amount
ID=###, R6_ID, W_ID, R_ID
Rayleigh model (AMF)
ID
Total ozone
ID= ###, O3_ID, Absrp_ID, Slant_ID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ID=###, R6_ID, W_ID, R_ID
Rayleigh model (AMF)
ID

Implementation

Web-based applications on your PC

- Open-source software allows to run web-based applications on a single computer

- That same computer can be a server and database queries can be send via LAN or the Internet

Web-based applications on your PC

- Open-source software used:
  - Apache web-server
  - PHP interpreter
  - MySQL database engine
- The code is done in PHP
  - Scripting language allows to change the program quickly when needed

What has been done

- PHP code fully separated from the data: it is abstract, i.e. the program doesn't know what it is reading. It gets the formatting information from the database.
  - Reads tag-based files (ds 0 ….)
  - The same code reads both existing records (DS, HG, SL,…) and those that have not been yet implemented
  - Database tells what records are known and how to read them
- Web-based interface for accessing data
- Database accumulates useful queries for future use

What has been done

- Calculation of ozone from raw counts - done
- Calculation of effective ozone absorption – nearly done
- Caching of results - done

Brewer diagnostics

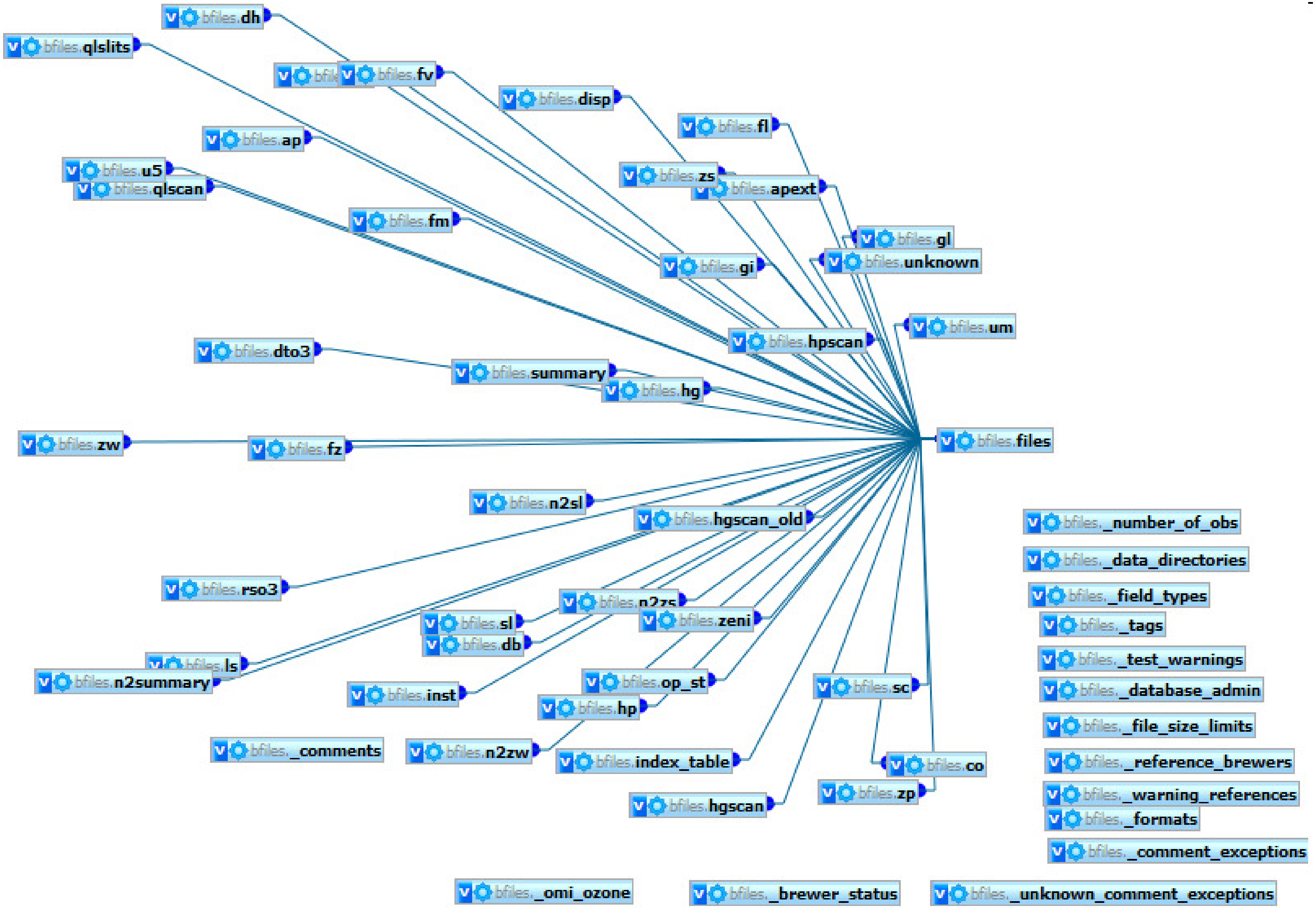
- Using the database approach we can prepare reports about the data that have been collected
  - Identify outliers easily
  - Keep track of SL and other tests
  - Use some intelligence in the diagnostics by analyzing several type of tests/observations together
    - What leads to the HG failure?
    - Did we forget to do HP before HG on a MKIII?

Current database organization

- Data are put into the database tables based on their tag
  - DS table
  - HG table
- Data from all instruments go in one table
  - Instruments can help each other to identify problems: why one Brewer made a good DS at noon last Friday and the other didn't?

Current database organization

- Known tags have their columns of data named
- For unknown tags columns have “field_1” type of names – it is an option.
- Unknown/unrecognized records are put in a separate table and files with those are copied to a separate directory for ease of dealing with them
- Recognized but erroneous (wrong formatting) records are put in normal tables but marked



bfiles.dh
bfiles.qlslits
bfiles.fv
bfiles.disp
bfiles.fl
bfiles.ap
bfiles.u5
bfiles.qlscan
bfiles.zs
bfiles.apext
bfiles.fm
bfiles.gl
bfiles.unknown
bfiles.gi
bfiles.um
bfiles.hpscan
bfiles.dto3
bfiles.summary
bfiles.hg
bfiles.zw
bfiles.fz
bfiles.files
bfiles.n2sl
bfiles.hgscan_old
bfiles._number_of_obs
bfiles._data_directories
bfiles._field_types
bfiles.rso3
bfiles.zeni
bfiles.sl
bfiles.db
bfiles._tags
bfiles._test_warnings
bfiles.ls
bfiles.n2summary
bfiles.inst
bfiles.op_st
bfiles.hp
bfiles.sc
bfiles._database_admin
bfiles._file_size_limits
bfiles._comments
bfiles.n2zw
bfiles.index_table
bfiles.co
bfiles._reference_brewers
bfiles.zp
bfiles._warning_references
bfiles.hgscan
bfiles._formats
bfiles._comment_exceptions
bfiles._omi_ozone
bfiles._brewer_status
bfiles._unknown_comment_exceptions

Measurements and tests summary.

_jday	_serial	aod	aode	ds	hg	hp ▲	ls	s1	sl	uv	zs
251	#		99	100	24	75			3	2	30
252	#	106		106	32	63			8	5	8
251	#		51	51	35	60			7	16	7
252	#	96		97	33	59			8	4	3
252	#		98	99	31	58			7	7	3
252	#		86	86	35	56			5	8	8
254	#		80	82	30	52			5	6	4
252	#		75	75	29	52			7	3	6
253	#	77		78	32	51			5	5	3
253	#	100		100	27	48			7	14	6
255	#		52	54	32	47		4	7	16	5

Warnings about the number of observations and tests

Fully configurable.
All criteria are in the database tables

Helps with scheduling issues for observations.

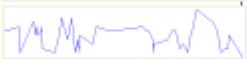
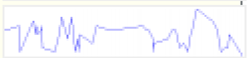
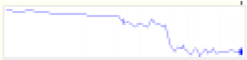
Questionable Run/Stop results. (0 sec)

Serial	Jday	slit 0	dark rs	dark counts	slit 1	slit 2	slit 3	slit 4	slit 5 ▾	slits 3+5
	2009256	0.9986	1.1667	112 / 96 (0.9M)	0.9984	0.999	0.9472	0.9983	0.8982	0.9994
	2009256	0.9333	1.2143	17 / 14 (1.4M)	0.8997	0.8999	0.9005	0.8992	0.8995	0.8996
	2009256	1.0001	1.1386	115 / 101 (0.9M)	1.0002	0.9996	0.9998	0.9991	0.9964	1.0005
	2009251	1.0031	0.9787	46 / 47 (0.6M)	0.9998	0.9993	0.9997	0.9999	0.9979	1.0006
	2009253	0.9998	3.4082	167 / 49 (1.6M)	0.9994	0.9998	0.9998	0.9978	0.9979	0.9998
	2009255	0.9958	0.8333	10 / 12 (0.6M)	0.9996	0.9994	0.9999	0.9984	0.998	1.0001
	2009257	0.9988	8.5882	146 / 17 (1.6M)	1.0006	0.9992	0.9988	0.9982	0.9984	1.0009
	2009256	0.9983	0.4	2 / 5 (1.5M)	0.9991	0.9996	0.9996	0.9996	0.9985	1.0012
	2009254	0.9969	1	30 / 30 (0.6M)	1.0004	0.9994	1.0002	0.9995	0.9986	0.999
	2009255	1.0001	3.9302	169 / 43 (1.6M)	1.0001	0.9995	1.0001	0.9988	0.9986	1.0001

Measurements and tests summary.

_jday	_serial	aod	aode	ds	hg	hp	ls	s1	sl	uv	zs
254	#			77	28				8	82	3
253	#			43	20				3	71	4
256	#		113	115	29				8	24	6
255	#			116	34				10	24	6
255	#			68	28	30			7	24	3
256	#			68	29	30			8	24	4

Standard lamp R6 (0 sec)

File name	Count ▾	Serial	Expected (+/-20)	Measured	30-day history
b25009.	1	#	2110	2180	
b25709.	1	#	2110	2174	
b25709.	1	#	2230	2333	
b25409.	1	#	2000	1962	

Standard lamp intensity analysis (0 sec)

Serial	min	max	filter	fixable	30-day history
#	258237	382429	0		
#	467678	532804	1	yes	
#	212596	578919	1	yes	
#	626126	657883	0		
#	666068	674760	1		
#	739986	766279	0		
#	760440	778696	0		
#	314565	899841	0		

Suspicious HG test results (correlation<0.98 or counts<5000). (0 sec)

Serial	Jday	count	Peak	min.corr.	max.corr. ▲	30-day history
#	255	4	15865	0	0.9797	
#	252	4	250	0	0.9796	
#	254	1	42469	0.9716	0.9716	
#	250	1	74650	0.9676	0.9676	
#	254	1	168307	0	0	

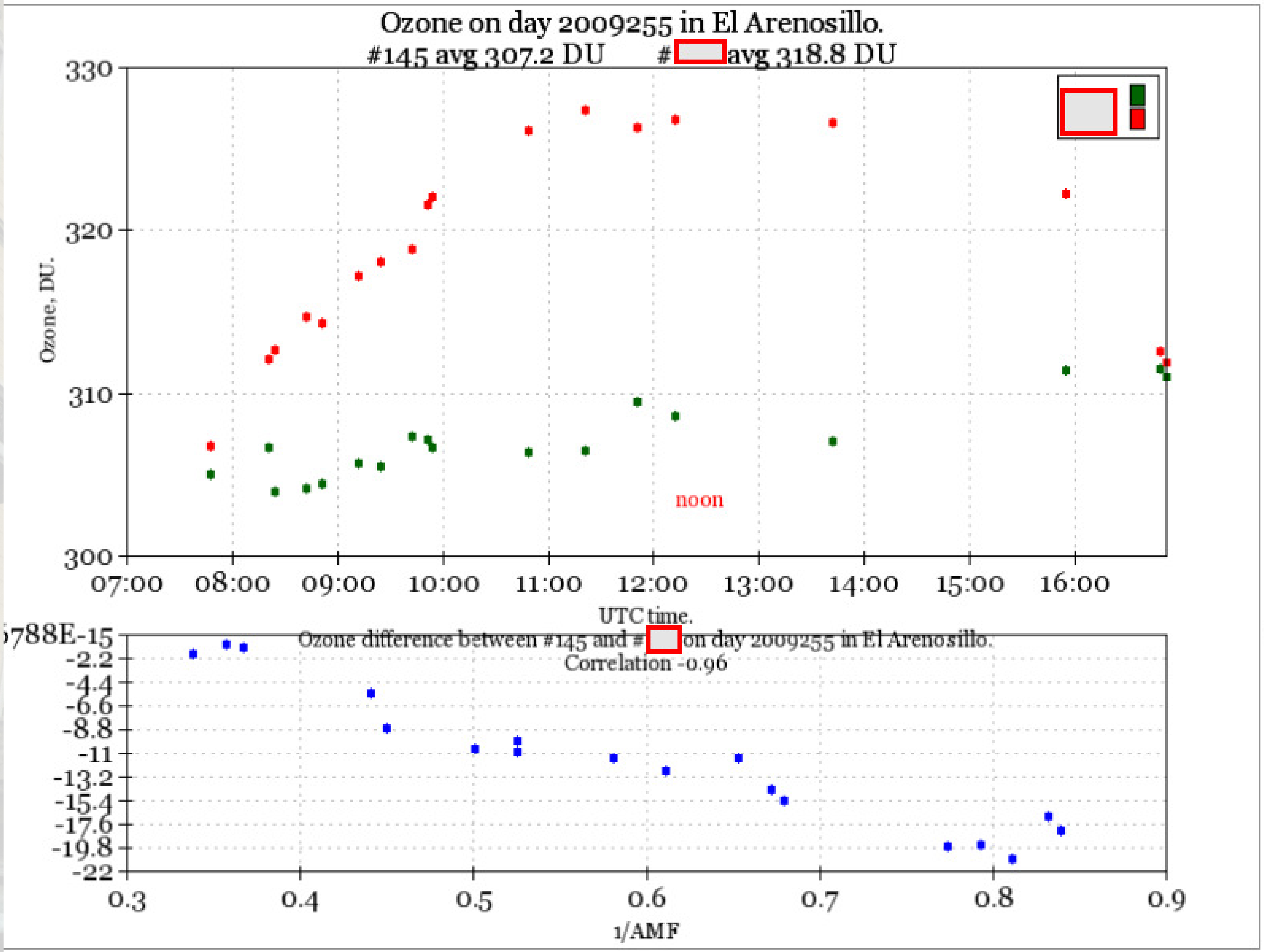
AP results for MB Brewer. (1 sec)

Serial	Jday	t1 off	t1 on	t2 off	t2 on	t3 off ▾	t3 on	HV off	HV on	+15V off	+15V on	+5V off	+5V on	-15V off	-15V on	+24V off	+24V on	+5V sps off	+5V sps on	-8 sp o
017	2009250	-30.0	-1.7	-30.0	-0.8	-10.8	-1.6	1408.2	1402.7	15.1	15.0	5.0	5.0	-14.9	-14.9	23.6	23.7	4.9	4.9	-8
051	2009251	21.4	21.2	22.1	21.7	21.6	21.2	1490.2	1457.4	14.8	14.3	4.9	4.8	-15.1	-15.0	24.4	25.2	4.6	4.6	-8
051	2009252	22.6	22.5	22.8	22.7	21.8	21.4	1488.4	1464.7	14.8	14.3	4.8	4.8	-15.1	-15.0	24.4	25.1	4.6	4.6	-8
145	2009258	22.6	22.5	23.0	22.8	22.1	22.1	1260.5	1256.8	14.9	14.8	5.1	5.0	-14.9	-14.9	23.6	23.7	5.0	5.0	-7
165	2009258	22.5	22.5	23.0	23.2	22.1	22.1	1337.1	1337.1	14.8	14.8	5.1	5.1	-14.9	-14.9	23.6	23.9	5.1	5.1	-7
070	2009 [illegible]	[illegible]	[illegible]	-10.2	-10.2	23.4	23.4	1446.5	1446.5	14.9	14.9	5.1	5.0	-15.1	-15.1	23.5	23.7	4.9	4.9	-8

not a high priority

Ozone results for good DS obs (std<2.5DU, mu<3) within 3 minutes between 2 Brewers. (2 sec)

Location	Count	Reference ▲	Brewer	Day	Ozone average for B1	Ozone average for B2	% difference	ETC suspect?
El Ar	8	#145	#	2009255	309.9 +/- 1.5 DU	341.4 +/- 10.5 DU	10.2	
El Ar	16	#145	#	2009255	307.2 +/- 2.6 DU	278.7 +/- 4.9 DU	9.3	yes
El Ar	18	#145	#	2009255	307.2 +/- 2.3 DU	318.8 +/- 6.2 DU	3.8	yes
El Ar	16	#145	#	2009255	308.3 +/- 3.2 DU	314.4 +/- 6.3 DU	2.5	
El Ar	25	#145	#	2009255	307.7 +/- 2.8 DU	308.6 +/- 5.2 DU	1.5	yes
El Ar	20	#145	#	2009255	307.2 +/- 2.1 DU	303.7 +/- 2.1 DU	1.1	
El Ar	25	#145	#	2009255	308.0 +/- 2.6 DU	309.1 +/- 4.6 DU	0.9	
El Ar	17	#145	#	2009255	308.1 +/- 3.1 DU	306.0 +/- 3.0 DU	0.9	
El Ar	6	#145	#	2009255	310.7 +/- 2.3 DU	312.9 +/- 0.6 DU	0.8	
El Ar	22	#145	#	2009255	307.5 +/- 2.3 DU	305.5 +/- 1.8 DU	0.8	
El Ar	14	#145	#	2009255	307.6 +/- 2.6 DU	305.6 +/- 2.3 DU	0.7	
El Ar	17	#145	#	2009255	306.8 +/- 2.7 DU	305.6 +/- 3.3 DU	0.7	
El Ar	19	#145	#	2009255	307.7 +/- 2.2 DU	308.4 +/- 2.9 DU	0.6	yes
El Ar	16	#145	#	2009255	307.7 +/- 2.5 DU	308.6 +/- 2.9 DU	0.6	yes
El Ar	16	#145	#	2009255	306.7 +/- 1.9 DU	306.4 +/- 2.9 DU	0.5	
El Ar	9	#145	#	2009255	308.8 +/- 1.6 DU	308.9 +/- 2.7 DU	0.5	
El Ar	*29*	*#145*	*#145*	*2009255*	*307.9 +/- 2.7 DU*	*307.9 +/- 2.7 DU*	*0.0*	


Ozone on day 2009255 in El Arenosillo.
#145 avg 307.2 DU # avg 318.8 DU
Ozone, DU.
noon
UTC time.
Ozone difference between #145 and # on day 2009255 in El Arenosillo.
Correlation -0.96
1/AMF

Conclusions

- This database approach has been successfully implemented at the Canadian Brewer Network
- Next step is a WWW-accessible version for everybody to use and play

I'd like to acknowledge Tom McElroy, David Wardle, Ken Lamb and many others who provided invaluable input to this project.