



## Twining report Danum Valley 2012, Malaysia

Global station in WMO RA II

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The twinning visit of the station took place from March 20<sup>th</sup> to 29<sup>th</sup> 2012. This years visit was extended because of an intensive measurement campaign by TROPOS at the site. During this intensive campaign aerosol particle number size distribution has been measured for a time period of 3 months using an SMPS and a Grimm OPC. Furthermore a polar Nephelometer was used to investigate scattering properties of the aerosol at Danum Valley.

To improve aerosol drying capacity a compressor with adsorption dryer was donated to the station by TROPOS (figure 1).



Figure 1: New compressor an Danum Valley

With this dryer setup a reduction of aerosol humidity from an average of 57% to 40% was achieved. Figure 2 shows the frequency distribution of relative humidity as measured by the Nephelometer.

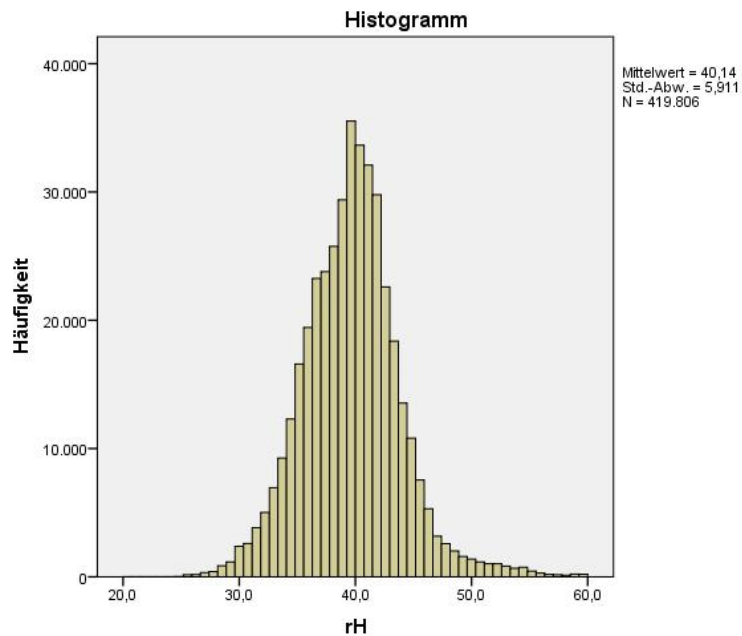


Figure 2: Frequency of 1 minute relative humidity at Danum Valley with new aerosol dryer setup.

Tropos donated an new Ecotech Aurora 3000 three wavelength Nephelometer tot he station. This instrument has been modified at TROPOS to allow for automatic zero checks at the common inlet. Figure 3 shows the instrument at the station.



Figure 3: (from front to back) polar nephelometer Aurora 4000, new 3-wavelength nephelometer Aurora 3000 and old nephelometer.

Logbook of the standard activities during the twinning visit:

20.03.2012 01:57 Logbook started  
 20.03.2012 01:58 arrival at the station, everything up and running  
 20.03.2012 01:58 local time is 08:58  
 20.03.2012 04:52 compressor installed outside  
 20.03.2012 04:52 daz inside  
 20.03.2012 05:19 initial rh 59% down to 36 % at 92% ambient 23.5 C  
 20.03.2012 05:19 compressor dewpoint temperature 5 deg C  
 20.03.2012 05:28 dry air flow is 30 l/min  
 20.03.2012 07:10 stop eccotech single wavelength Nephelometer  
 20.03.2012 07:10 Note should be run in parallel for 2 months when Sascha leaves  
 20.03.2012 07:28 install aurora 3000 and 4000, run zero and span check  
 20.03.2012 09:09 Aurora 3000 zero adjust, span check ok  
 20.03.2012 09:09 install software on aerosol PC using old COM port  
 20.03.2012 10:02 Aurora 3000 up and running  
 20.03.2012 10:49 14.4 minutes for spancheck to stabilize using Kalman filter  
 20.03.2012 10:49 standard Span check time should be set to 20 minutes

20.03.2012 10:49 run overnight zero for aurora 3000 accuracy  
20.03.2012 10:52 start span check aurora 4000  
20.03.2012 10:59 restart old Neph for overnight measurements  
20.03.2012 11:00 aurora 3000 is running zero to determine instrument noise  
20.03.2012 11:12 restart neph opld  
21.03.2012 03:52 Logbook started  
21.03.2012 03:52 Setup SMPS  
21.03.2012 03:52 SMPS not running 5 Volt card disconnected in electronics  
21.03.2012 03:52 connect SMPS to main inlet using brass T for flow split to OPC  
21.03.2012 03:53 aerosol dryer not connected to check aerosol humidity  
21.03.2012 03:53 install if necessary  
21.03.2012 03:53 run SMPS with HV off - no butanol available to dry out system  
21.03.2012 05:25 restart aerosol pc because all daq programs did not run  
21.03.2012 05:32 Trying to connect to aerosol pc  
21.03.2012 07:27 local connect possible, data saved  
21.03.2012 09:17 SMPS HV calibrated  
21.03.2012 09:17 aerosol dryer leaking, repaired, flow CPC flow is 1.073 not correct  
21.03.2012 10:29 Connection of pressure sensor inside electronics box broken, disconnected  
21.03.2012 10:29 set sheath air flow to nominal 4.985  
21.03.2012 10:29 set pressure 955 hPa and Temperature 25 deg C  
21.03.2012 10:29 run setup  
21.03.2012 10:29 start zero scan  
21.03.2012 10:57 sheath air flow leaking, all ferrules loose  
21.03.2012 11:10 serial port has disappeared on SMPS PC  
22.03.2012 01:58 Logbook started  
22.03.2012 01:59 back at station  
22.03.2012 01:59 overnight measurement SMPS shows nice variation comparable to neph data  
22.03.2012 01:59 stop smps for zero measurement  
22.03.2012 02:21 zero shows 5 single particles during scan, ok  
22.03.2012 02:25 uninstall old neph  
22.03.2012 03:51 sheath air flow is 4.9 l/min 205 nm found at 206 ok  
22.03.2012 03:51 recheck HV  
22.03.2012 04:25 start smps routine measurement  
22.03.2012 05:58 SMPS up and running  
22.03.2012 08:20 Aurora 3000 set to zero check every 12 hours for 15 minutes storing 1 minute raw data  
22.03.2012 09:03 New software build for Aurora 3000  
22.03.2012 09:08 ifref ID 498172651 Das Kennwort ist sehr geheim 42  
23.03.2012 01:10 Logbook started  
23.03.2012 01:10 at station  
23.03.2012 01:15 Filter on main inlet local time 08:15  
23.03.2012 02:45 SMPS looks good, 2/cc or less, OPC ok, Neph ok, TEOM needs to be analyzed  
23.03.2012 04:43 remove zero filter from inlet local time is 11:42  
23.03.2012 06:39 SMPS flow is not correct, calibration was not done  
23.03.2012 06:39 last check was 1.07 l/min indicated 1.19

23.03.2012 08:08 Strange peaks with a period of about 5 weeks both in Neph and TEOM data of 2011

23.03.2012 08:08 No station access log, but peaks last for several days

23.03.2012 08:17 laptop gets to warm at room temperature 29.6

23.03.2012 09:18 power failure during thunderstorm

23.03.2012 11:31 interesting neph data and smps data

23.03.2012 11:31 quit for today

24.03.2012 01:49 Logbook started

24.03.2012 01:49 All up and running,

24.03.2012 02:04 TEOM zero is very bad avg6.4 -14 - + 27.8  $\mu\text{g}/\text{m}^3$

24.03.2012 02:06 stop teom

24.03.2012 02:21 TEOM measurement cell closing device tightend , seal inspected

24.03.2012 02:21 TEOM filter changed

24.03.2012 02:59 Add Nephelometer new to Danum Website

24.03.2012 03:21 Start new zero measurement TEOM with in line filter

24.03.2012 03:48 GAWSIS website update New Nephelometer and SMPS/campaign

24.03.2012 04:01 Neph rH around 40 % max 45 % at hot and humid conditions with severe thunderstorm in the afternoon

24.03.2012 07:49 TEOM still negativ, running zero overnight

25.03.2012 03:18 Logbook started

25.03.2012 03:19 TEOM much better now, Std.Dev 8 -> 2.5 while still drifting

25.03.2012 03:45 MAAP is 0.008  $\mu\text{g}/\text{m}^3$  during zero on 23.3, Std.Dev 0.4 good

25.03.2012 03:50 Reset TEOM using F1 key

25.03.2012 04:58 stop data on teom

25.03.2012 05:00 Verify correct calibration constant in TEOM

25.03.2012 05:08 indicated negative mass concentration corresponds to continous increase of oscilation frequency

25.03.2012 05:22 reduce all TEOM temperatures from 40 to 35 deg

25.03.2012 05:24 Sampling rate of SMPS aerosol flow sensor increased from 1k at 1 kHz to 10k @10 kHz

25.03.2012 05:47 SMPS clock was set to daylight savings time, changed

25.03.2012 06:06 stop SMPS for check of aerosol flow fluctuations

25.03.2012 06:10 flow fluctuations come from common inlet

25.03.2012 06:14 change slope to 0.285 -> 1.07 l/min at nominal flow rate

25.03.2012 06:18 oscilations probably due to teom pump or maap pump

25.03.2012 06:21 switch of TEOM pump and MAAP pump -> not the reason

25.03.2012 06:22 remove Aurora 4000

25.03.2012 06:38 fluctuations originate fromm MAAP pump

25.03.2012 07:21 works with a buffer water cylinder but this is not the final solution

25.03.2012 08:01 trying to bio

25.03.2012 08:01 build a muffler

25.03.2012 08:28 doesn't help back to buffer bottle

25.03.2012 08:29 Heavy thunderstorm

25.03.2012 08:51 1.1 mm in between 5 and 10 minutes

25.03.2012 08:53 weather station time is about 28 minutes late

25.03.2012 09:14 Time to leave

26.03.2012 02:35 Logbook started

26.03.2012 02:36 Back at the station local time 8:36

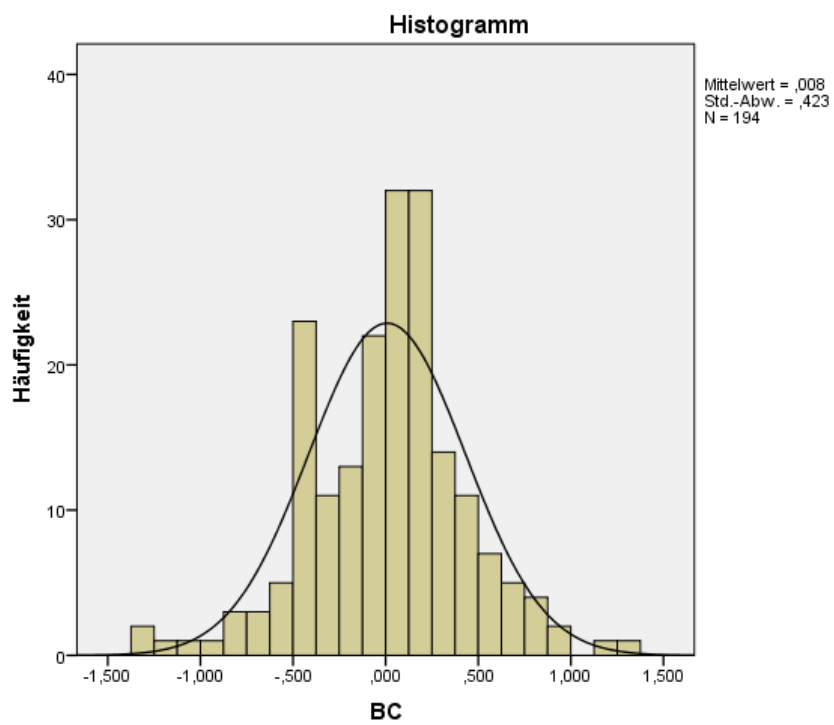
26.03.2012 02:36 all up and running TEOM seems to be ok now  
26.03.2012 02:57 Fluctuations of TEOM signal reduced  
26.03.2012 04:12 Std. Dev is now 1.17, offset 1 getting close  
26.03.2012 04:13 building a new damper "cakebox"  
26.03.2012 05:09 stop the smps for cakebox tryout  
26.03.2012 05:32 next problem is the internal pump of the opc  
26.03.2012 05:46 used a long tube to damp oscillations from OPC range now .98 to 1.12 for 1.07 real  
26.03.2012 05:47 put scan in autostart  
26.03.2012 05:56 autostart useless because of opc  
26.03.2012 06:29 Flowcheck + HV check SMPS ok, leave unchanged  
26.03.2012 06:51 Sheath air 4.92  
26.03.2012 06:51 Aerosol 1.05  
26.03.2012 07:28 TEOM much better with cakebok damper but MAAP shows pump error, works ok with this error  
26.03.2012 09:59 16:00 local time remove zero filter from TEOM  
26.03.2012 10:18 TEOM peak due to pressure fluctuation  
26.03.2012 10:18 restart TEOM program  
26.03.2012 10:45 restart not done leaving peak in data as usual  
26.03.2012 10:45 internet down  
26.03.2012 10:46 leaving station at 17:00 local  
27.03.2012 03:01 Logbook started  
27.03.2012 03:01 all instruments running  
27.03.2012 04:54 data evaluation  
27.03.2012 06:02 may be that the biweekly autocorrelation triggers the others  
27.03.2012 10:19 UPS check was never done during last years, test down to 50 % should be done monthly  
28.03.2012 02:59 Logbook started  
28.03.2012 03:00 ups chec started at 2:30, 8:30 local  
28.03.2012 03:07 DVFC internet access will be provided by SEARRP  
28.03.2012 04:33 peaks in neph, Maap teom on August 28th 2011 can be associated with hotspots in south borneo verified by hyslit  
28.03.2012 05:14 restart ups battery charger was still active  
28.03.2012 06:16 Electronic logbook installed on aerosol PC  
28.03.2012 06:17 writes to TEOM data file to be available by remote access  
29.03.2012 04:26 Logbook started  
29.03.2012 04:27 we tried to go down to the station, road was blockede by wild elephants  
29.03.2012 04:27 returned to the station sleeping in makeshift beds  
29.03.2012 04:27 10:20 local switch off SMPS for training start  
29.03.2012 04:28 reconnect all TROPOS instrument to run on UPS  
29.03.2012 04:28 UPS lasts about 12.5 hours  
29.03.2012 04:28 batteries do not need to be replaced now  
29.03.2012 04:42 repeat instructions to new instruments and dryer  
29.03.2012 05:33 doing zero adjust and span adjust for training purpose  
29.03.2012 05:34 checking SMPS flows and HV  
29.03.2012 06:46 HV check and flow check SMPS ok, leave everything unchanged  
29.03.2012 15:00 Logbook started

Quality assurance graphs:

MAAP zero is good:

BC statistics

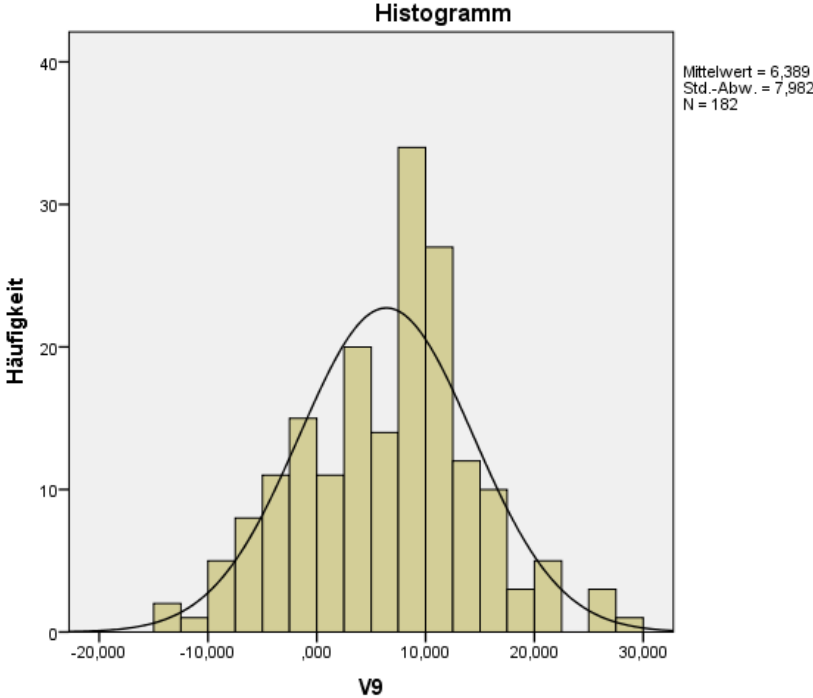
N	Gültig	194
	Fehlend	0
Mittelwert		,00761
Median		,03350
Standardabweichung		,422945
Minimum		-1,319
Maximum		1,254



TEOM Zero is bad

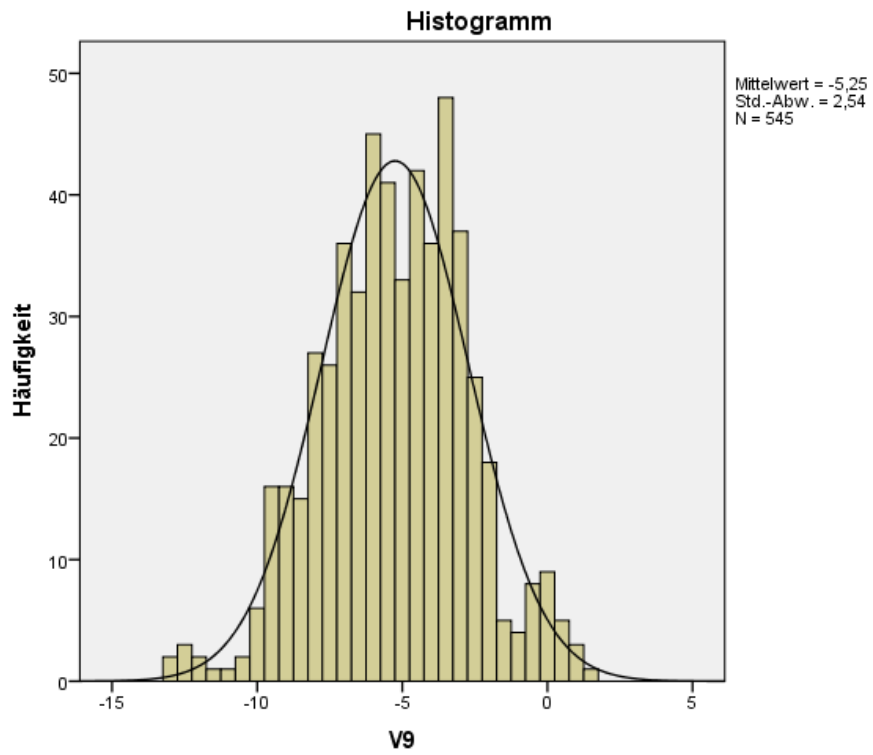
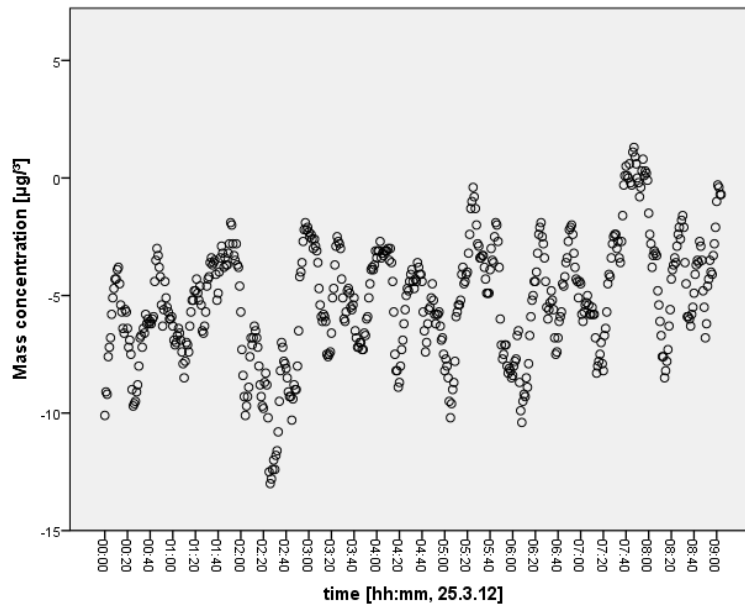
**Statistics of zero measurements.**

N	Gültig	182
	Fehlend	0
Mittelwert		6,38901
Median		7,90000
Minimum		-13,900
Maximum		27,800

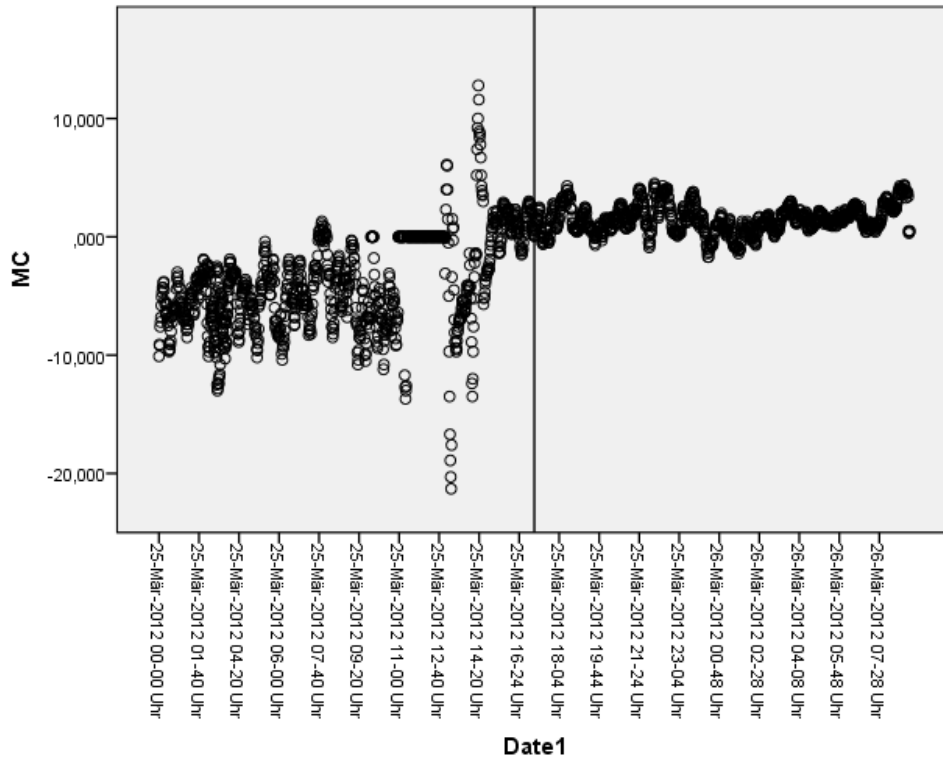




TEOM overnight run 25.3.2012 after repair and filter change, zero not yet reached



## Influence of fluctuation damper in front of MAAP pump

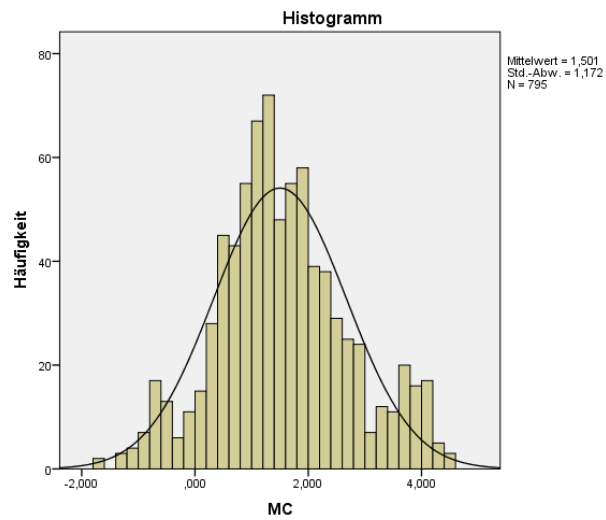


## TEOM with fluctuation damper

### Statistiken

MC

N	Gültig	795
	Fehlend	1142
Mittelwert		1,50088
Median		1,40000
Standardabweichung		1,172346
Minimum		-1,700
Maximum		4,500

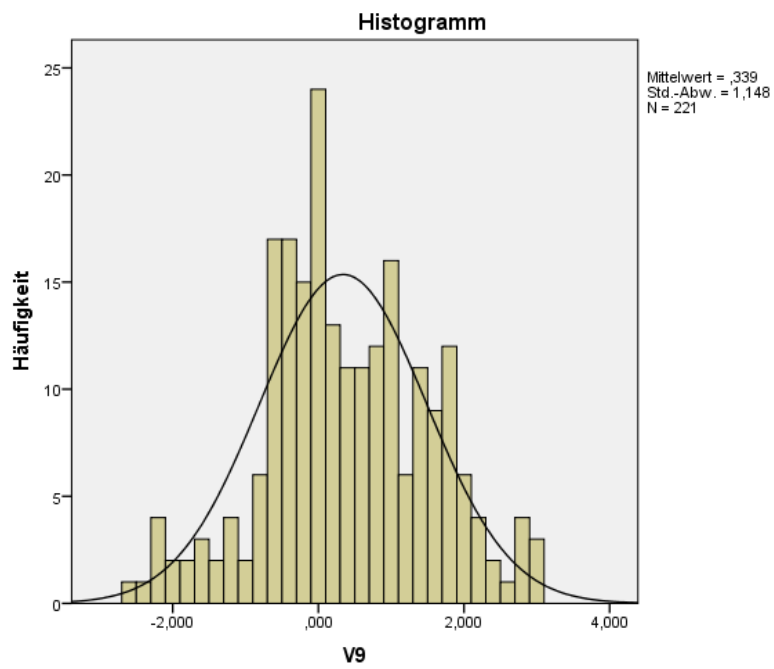


Run 3, everything done

### Statistiken

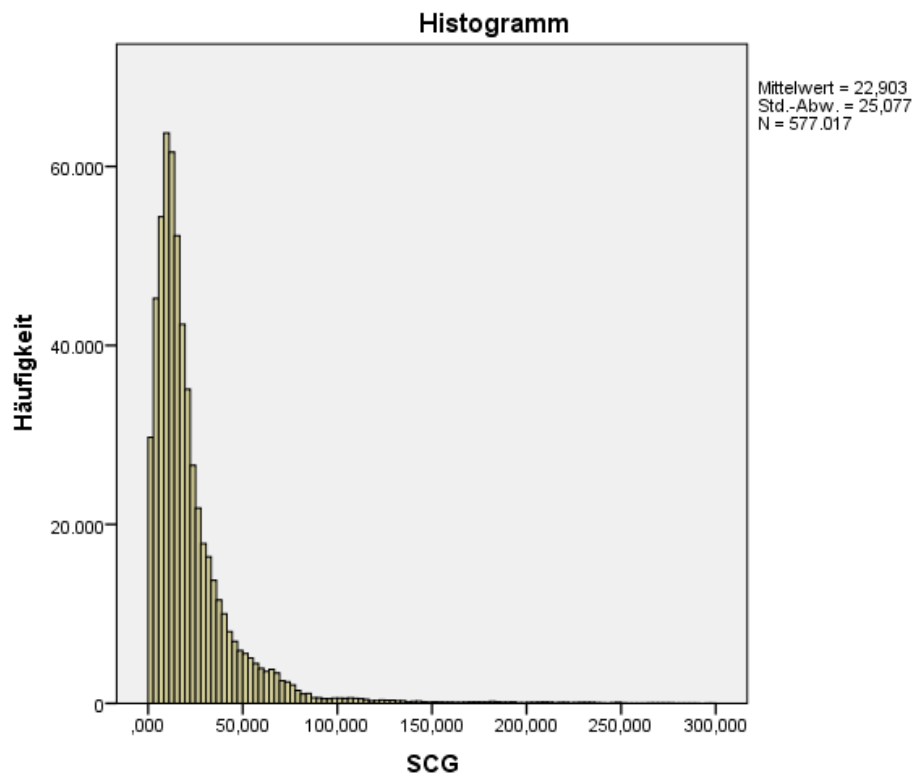
V9

N	Gültig	221
	Fehlend	0
Mittelwert		,33891
Median		,20000
Standardabweichung		1,148290
Minimum		-2,600
Maximum		3,000

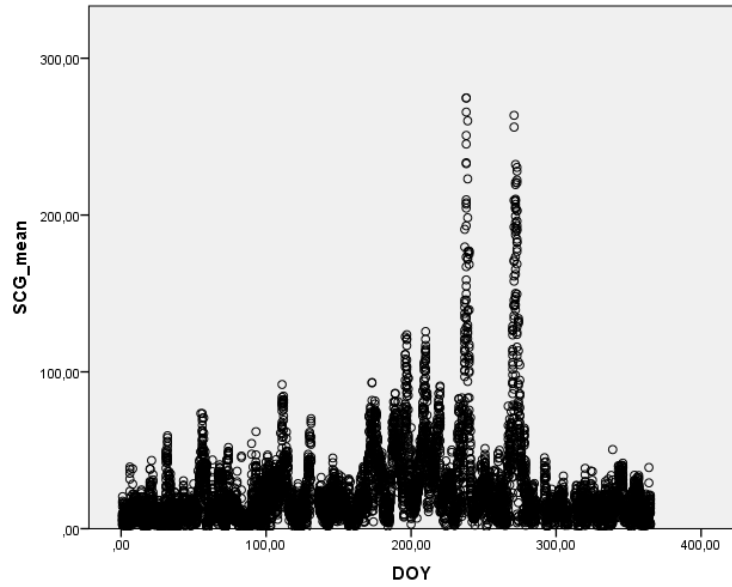


Nephelometer data 2011

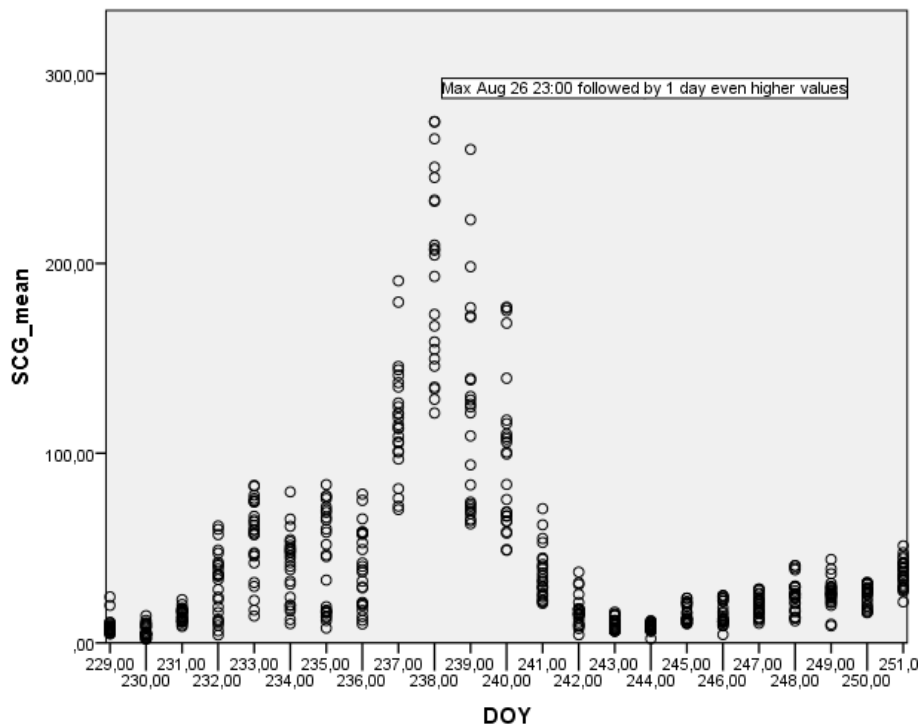
Frequency distribution



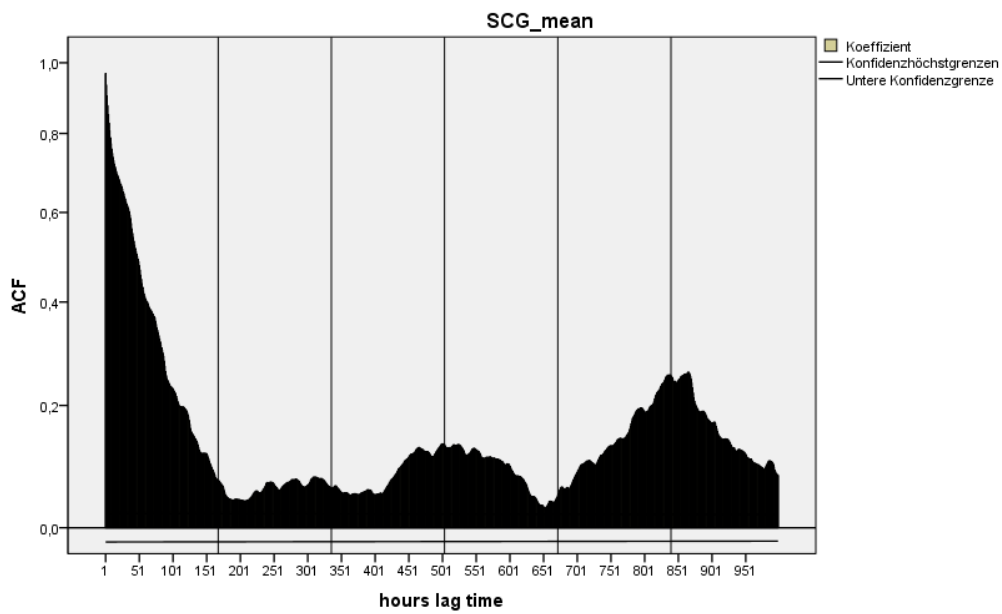
Time series hourly Nephelometer data cleaned



Detail of regular peaks in Nephelometer data

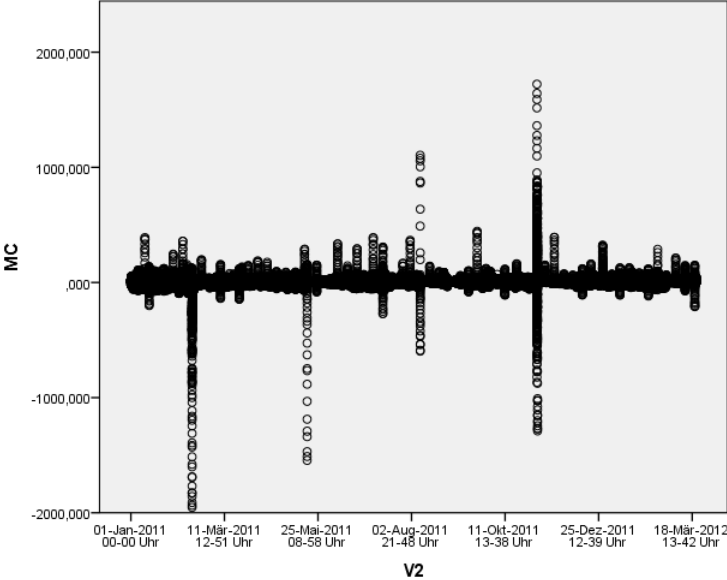


## Correlation function for peaks

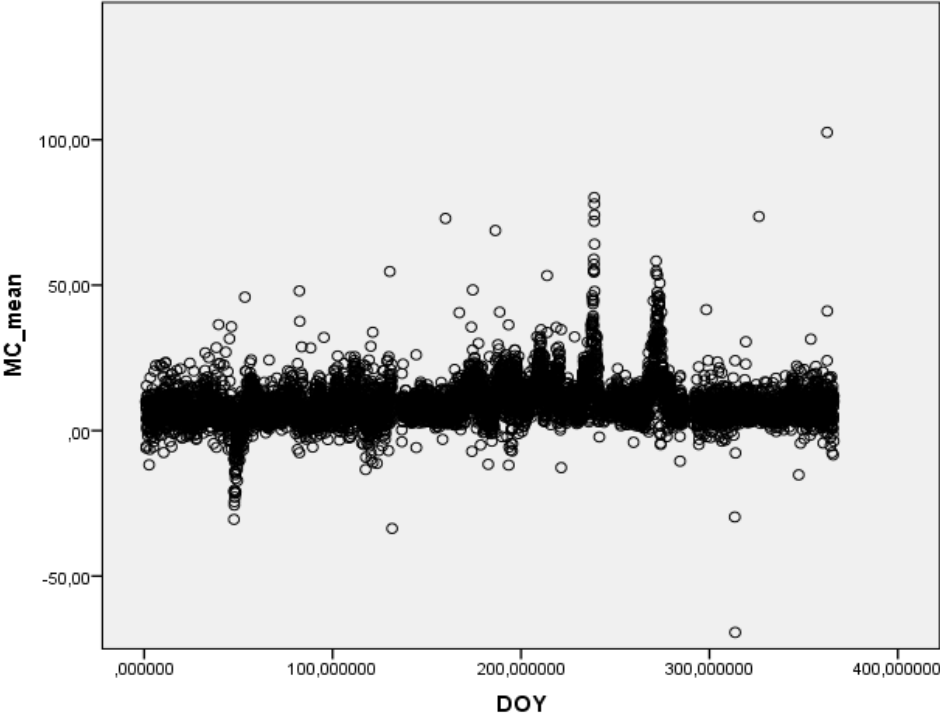


- Something happens every five week that causes a major peak in the time series of the Nephelometer data. This event can be found in TEOM data as well.

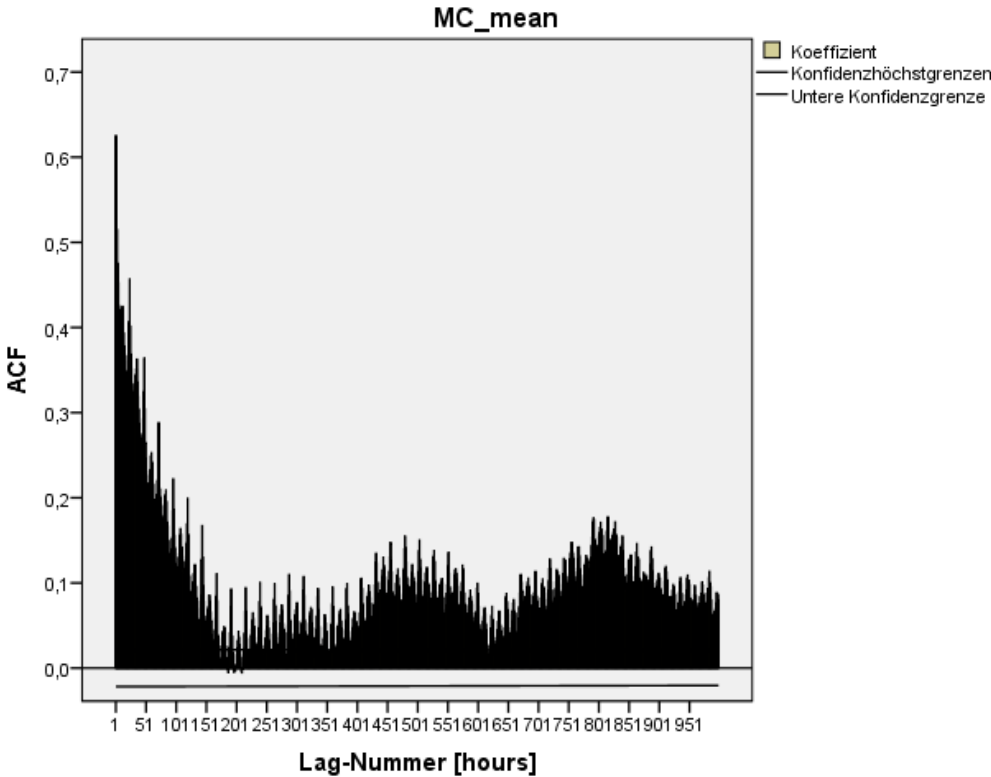
Time series 1 minute data TEOM



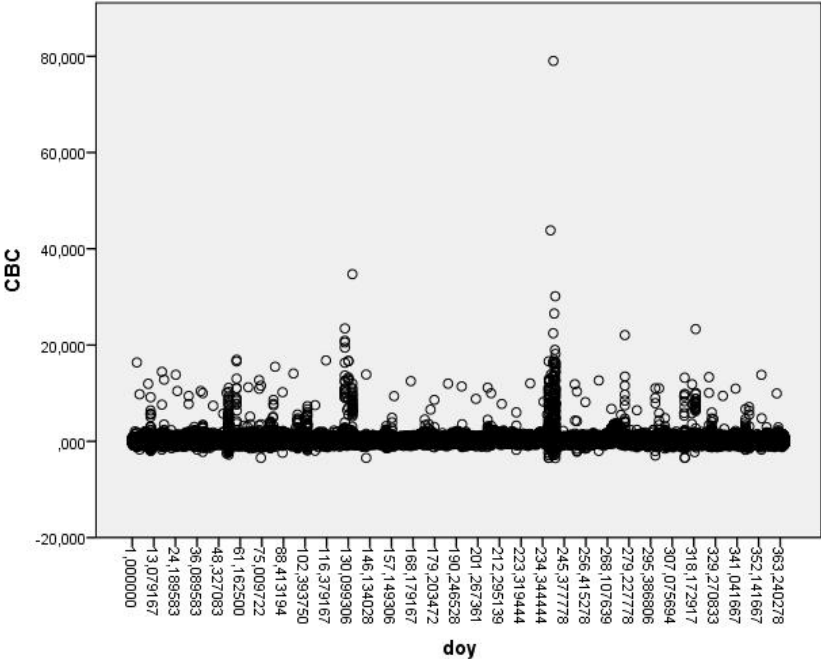
Hourly MC 2011



Autocorrelation TEOM mass concentration

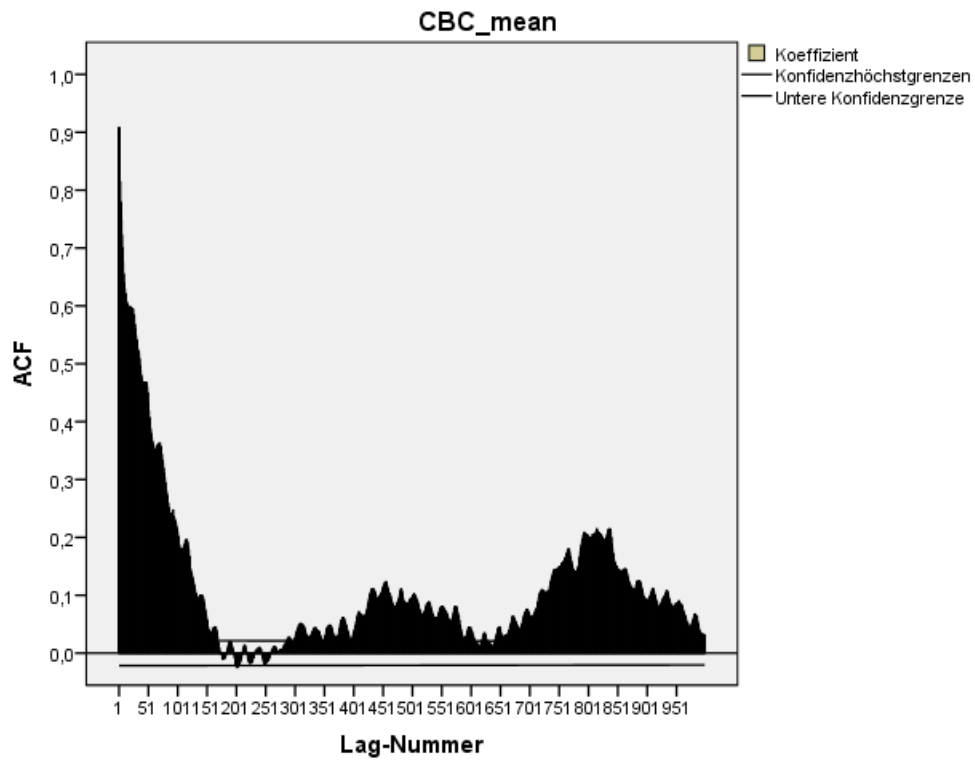


MAAP 1 minute raw time series

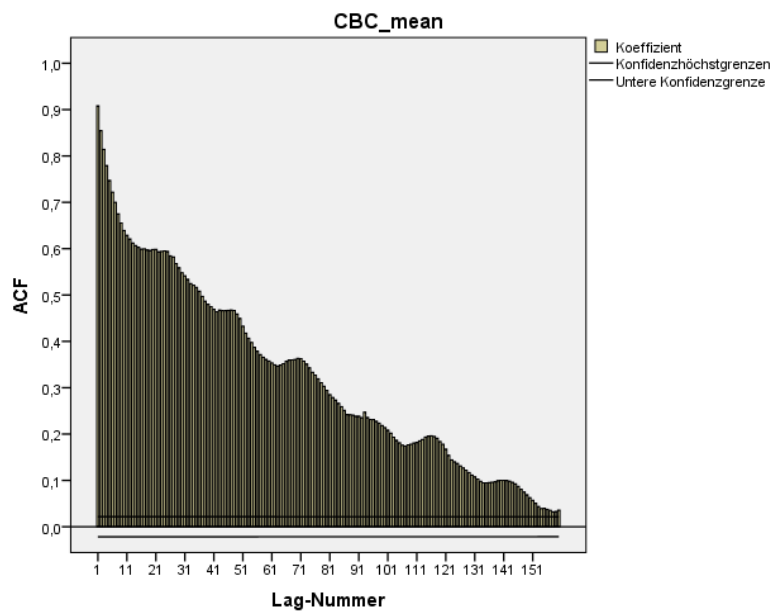




## MAAP autocorrelation



## Diurnal variability causes 24 hour and multiples autocorrelation



rH change with new drying system

