Site audit report Puy de Dome, France

Contributing station in WMO RA VI

Dr. Thomas Tuch, WCCAP

Site description:

The EUSAAR site Puy de Dome (figure 1) is located in the Department Puy de Domes on the summit of a volcano at 45.77190°N 2.96580°E (1465 m a.s.l.) about 30 minutes drive from the city of Clermont Ferrand. Measurements have recently been transferred to a new laboratory building. An army station is located about hundred meters to the north of the new laboratory. This military station is occasionally using a diesel generator which may cause severe local pollution. This source of local pollution is however so close to the site that the use of the generator can be easily identified in the data set and removed. Another local source may become relevant in the future when the railway to the summit of the volcano is finished and the restaurant about 400 m SW of the station will open regularly.

Figure 1: Picture of the sampling site Puy de Dome.

The positive aspect of the construction of the new railway is that private cars and buses are now banned from the road to the summit of Puy de Dome. Measurements of physical aerosol properties at this have been audited by the WCCAP 22nd and 23rd of February 2011.

Documentation and data handling:

The site is operated by several persons who are responsible for single instruments and perform routine service of all instruments. Detailed operating procedures are available for all instruments for this purpose. Weekly check lists and instrument manuals are kept at the university. This is in this case feasible because the university is only 30 minutes from the site and major maintenance of the instruments is one there.

All data from the site have been submitted on time to the EBAS database.

Documentation and data handling comply with EUSAAR standards.

Primary flow standard:

A Gilibrator with 3 flow cells is used as primary flow standard. The high flow cell s/n 0710024H was verified against the WCCAP primary flow standard. Results of this check are shown in figure 2. The standard flow cell 0710051S was not working during the audit and needs to be repaired.

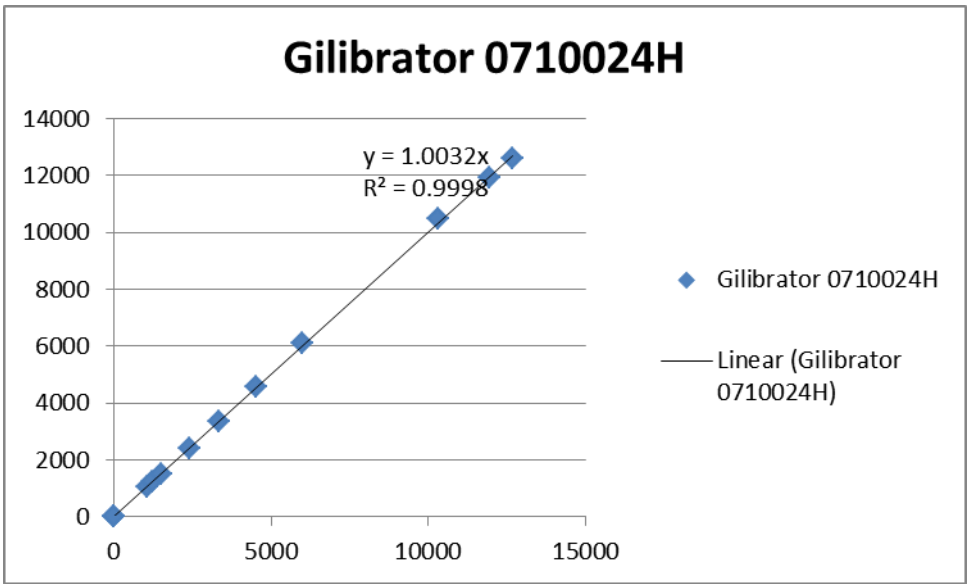

Figure 2: Primary flow standard at Puy de Dome.

The primary flow standard at Puy de Dome complies with EUSAAR standards.

Inlets:

Two whole air inlets with windbreakers are used for aerosol sampling at Puy de Dome (figure 3). One of these samples whole air the other one interstitial aerosol. Only one inlet was finished at the time of the audit, the installation of the heating of the second inlet had not yet been finished. The main sample flow in the inlet is 112 m^3/h. The sampling tube has inner diameter of 97 mm. The outer tube is heated

Figure 3: High flow aerosol inlet at Puy de Dome.

All aerosol lines are made of stainless steel. The flow splitter (figure 4) can be removed easily to attach an absolute filter for zero checks of the instruments. Conductive black tubing is used for the aerosol lines from the splitter to the instruments.

Aerosol inlets at Puy de Dome comply with EUSAAR standards.

Figure 4: Aerosol splitter in the laboratory building.

SMPS:

A custom made SMPS is used to measure number size distribution at Puy de Dome. The instrument consists of a long TSI DMA 3081 operated at 7:1 l/min. A corona charger developed at the technical university of Cottbus is used to neutralize the aerosol because radioactive sources are not permitted at the station. Because of the uncertainties implied by the use of this charger we suggest an inter-comparison with the travelling standard SMPS of the WCCAP. Sheath air is dried by diffusion dryer. A diffusion dryer is available for aerosol drying in summer. This dryer was however not installed during the audit. The aerosol was dry because of the temperature difference between ambient air and the laboratory building at an outside rH of 100%. We suggest the use of the diffusion dryer throughout the year to avoid possible jumps in concentrations when switching between an inlet with or without dryer. Concentrations of the monodisperse aerosol are measured by a TSI CPC. 3010 s/n 70508146.

The sheath air flow was measured at 7.025 l/min in good agreement with the software indicated sheath air flow of 7.025 l/min. Monodisperse aerosol flow was displayed as 0.96 l/min. We measured a flow rate of 1.045 l/min. The displayed flow rate was adjusted

accordingly. The false count rate of the CPC with an absolute filter was 3.8 10^{-4} cm^{-3}. 200 nm PSL particles where sized at 195.87 nm (figure 5).

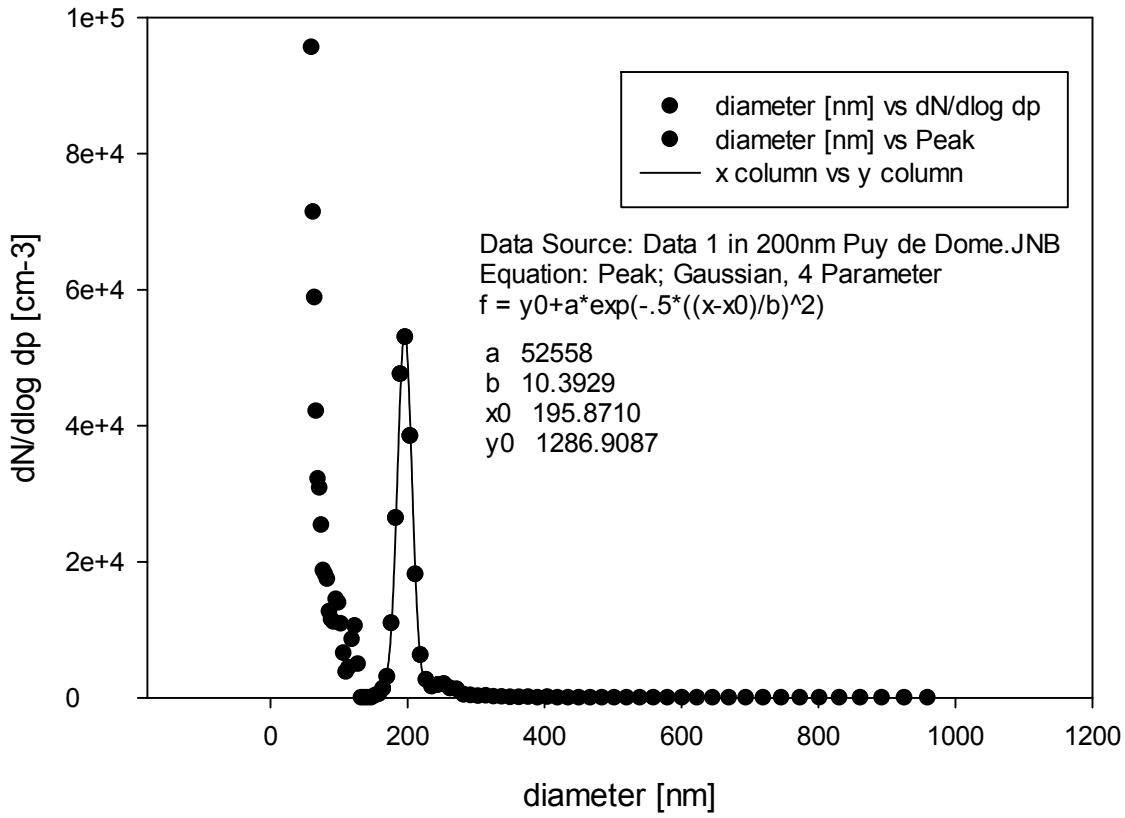

Figure 5: Sizing test of the SMPS at Puy de Dome using 200 nm Latex particles.

The SMPS at Puy de Dome complies with EUSAAR standards.

Note: Data from the SMPS are available from the database. Plotting routines at EBAS do not function properly.

OPC:

A Grimm OPC 1.108, SN 8F060029 is used for sizing of larger particles. The instruments flow rate was measured at 1.262 l/min with a nominal flow rate 1.2 +- 2% l/min. OPC measures 0 cm-3 with an absolute filter attached.

The OPC is in good working condition.

Total CPC:

A TSI CPC 3010 s/n 70508145 is used to measure total particle number concentration. We determined a false count rate of 4 10^{-4} cm^{-3} typical for these instruments. The measured flow was 1.013 l/min. The instrument noise was determined during an overnight run with an

absolute filter in the inlet path. Summary statistics of one minute average data are given in table 1.

Summary Statistics

		CPC
N	valid	881
	missing	0
Mean		,00
Median		,00
Standard Deviation		,000

Table 1: Summary statistics of 1 minute average CPC data with absolute filter.

Figure 6 shows the 2009 time series of CPC measured number concentrations as retrieved from the database.

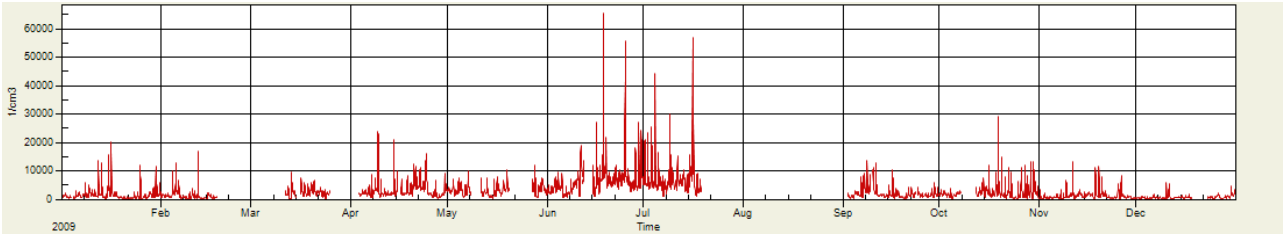

Figure 6: Total CPC data 2009 retrieved from EBAS.

The CPC is working within EUSAAR specifications.

HTMDA:

The custom made HTDMA at Puy de Dome is not operated in the context of EUSAAR. The instrument performs dry scans and Ammonium Sulfate scans automatically. The water CPC TSI 3782 s/n 70519005 had a false count rate of 1.2 10^{-3} cm^{-3}. We noticed a discrepancy between the CPC flow of 0.63 l/min and the flow at the inlet of the instrument of 2.819 l/min. This difference was probably due to a leak in a sheath air pump during the audit,

Nephelometer:

A TSI Nephelometer 3563 s/n 70511131 is used to measure scattering and backscattering coefficients. According to information available at the site this instrument was last calibrated 3.1.2011. According to EUSAAR standards span check or calibration of Nephelometers is required at least once per months. A calibration was performed during the audit. The screen shot (figure 7) demonstrates that at this time the calibration constants deviated from the old ones within the required 3% limit.

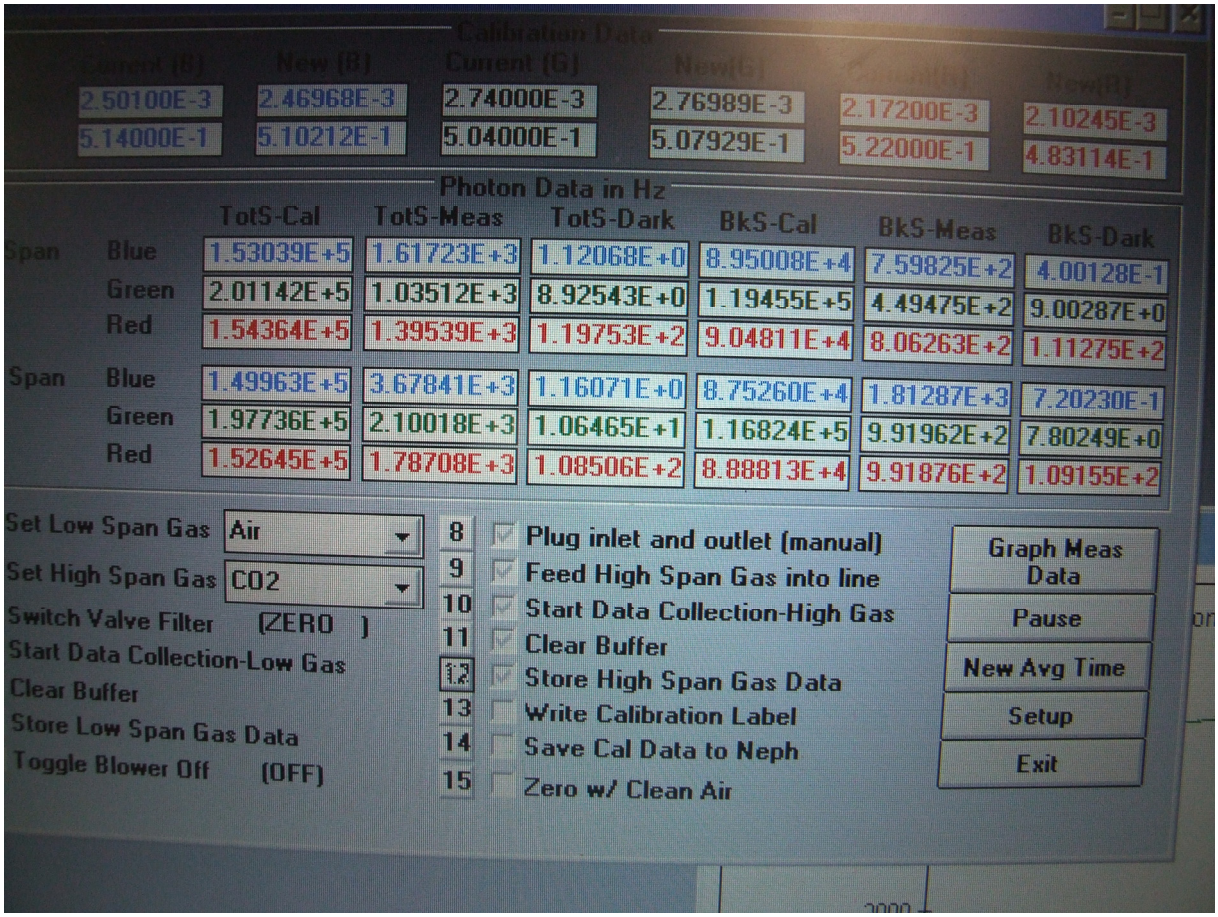

Figure 7: Calibration results for the Nephelometer.

The noise of the Nephelometer was checked during an overnight run with an absolute filter mounted to the main inlet. Summary statistics of 5 minute average data are given in table 2. Frequency distribution of measured scattering and backscattering coefficients by wavelength are shown in figure 8.

Summary Statistics

		TSC450	TSC550	TSC700	BSC450	BSC550	BSC700
N	Valid	154	154	154	154	154	154
	Missing	0	0	0	0	0	0
Mean		4,8883E-7	3,6220E-7	2,4498E-7	1,7202E-7	1,1002E-7	1,0888E-7
Median		4,7905E-7	3,5585E-7	2,4910E-7	1,7205E-7	1,1315E-7	1,1505E-7
Standard Deviation		1,7252E-7	1,1125E-7	1,0330E-7	8,8449E-8	6,2517E-8	8,1254E-8

Table 2: Summary statistics of 5 minute scattering and backscattering coefficients with absolute filter.

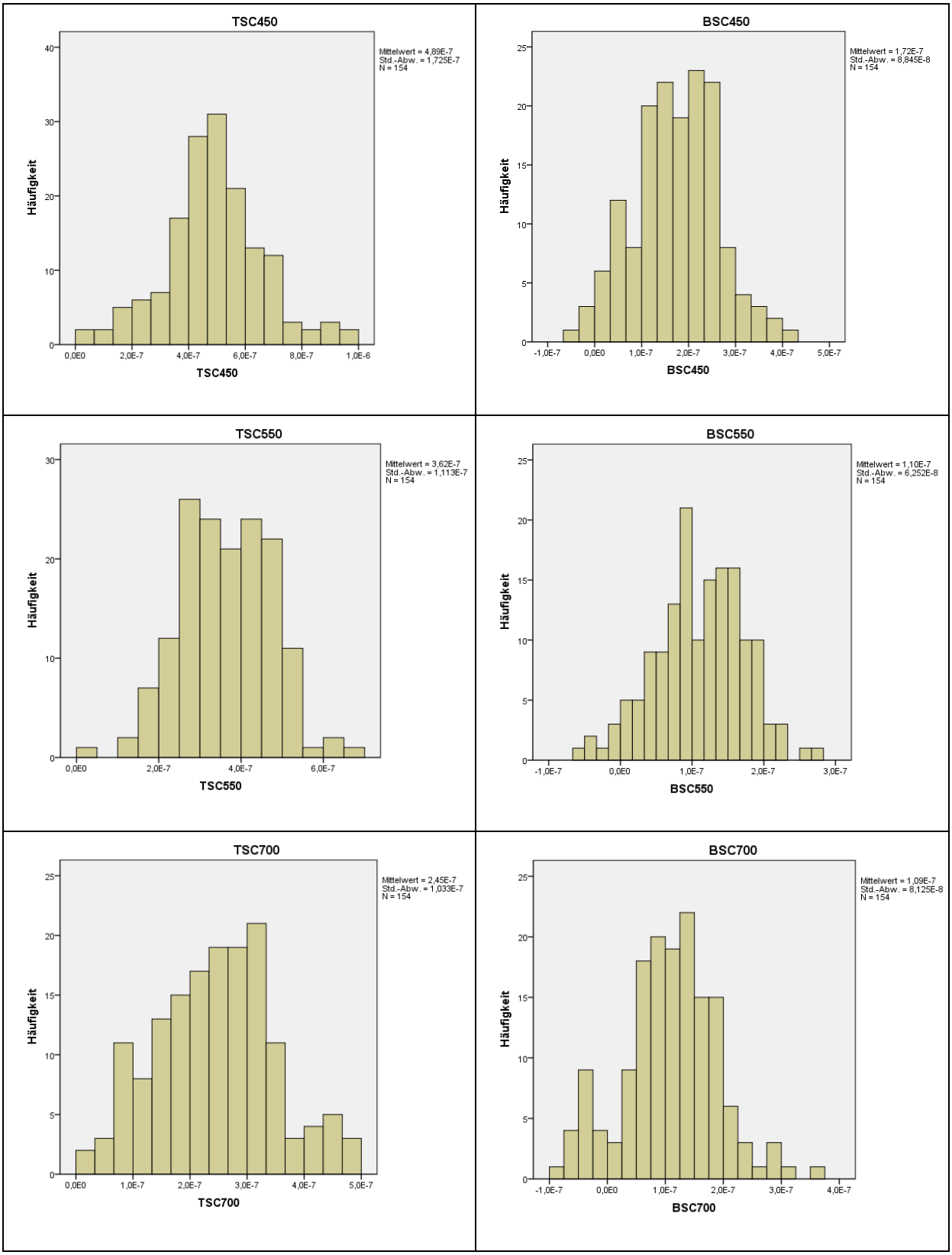

Figure 8: Frequency distribution of Nephelometer measurements with absolute filter, 1 minute data.

Hourly average scattering and backscattering coefficient as retrieved from EBAS for 2009 are shown in figure 9.

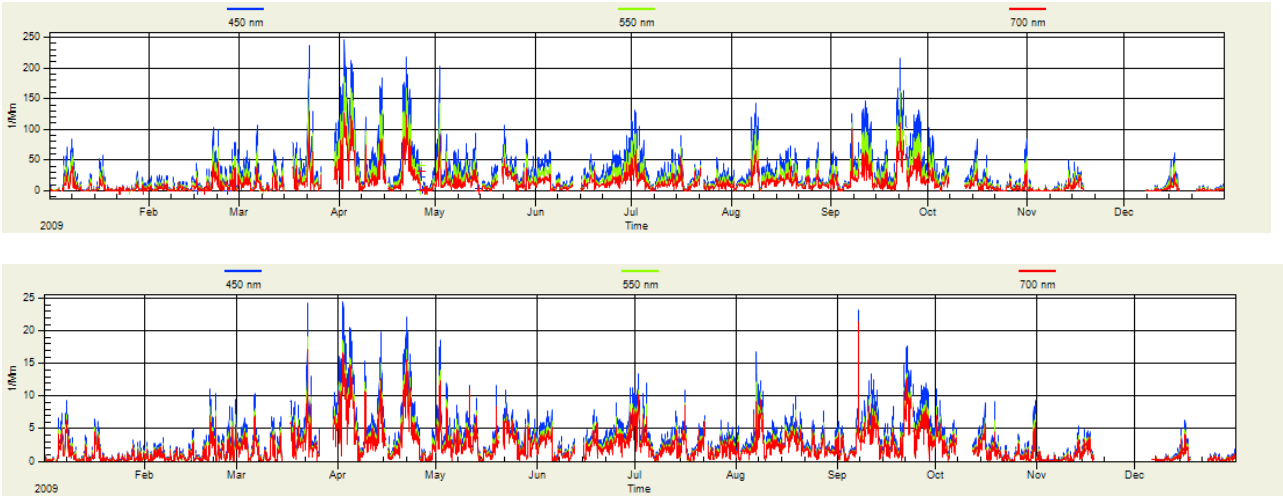

Figure 9: Scattering and backscattering coefficients (1-hour) 2009 retrieved from database.

MAAP:

A MAAP s/n 098 is used to measure absorption coefficients at Puy de Dome. Prior to the audit the instrument changed filters at 20% transmission (factory setting). Because of problems related to the underlying ray-tracing theory with highly loaded filters a filter change is recommended 70% transmission. The instrument setting was changed accordingly.

The internal flow meter of the MAAP indicated a flow of 16.66 l/min with a measured flow rate of 16.05 l/min. The internal flow meter was adjusted to 16.66 l/min. The instrument was run overnight with an absolute filter at the inlet. Summary statistics of these measurements are given in table 3.

Summary statistics

	BC
valid	842
missing	39
Mean	-1,102138
Median	,000000
Standard Deviation	12,0496010

Table 3: Summary statistics of 1 minute MAAP indicated black carbon concentrations with absolute filter.

Figure 10 shows the frequency distribution of one minute data with the absolute filter.

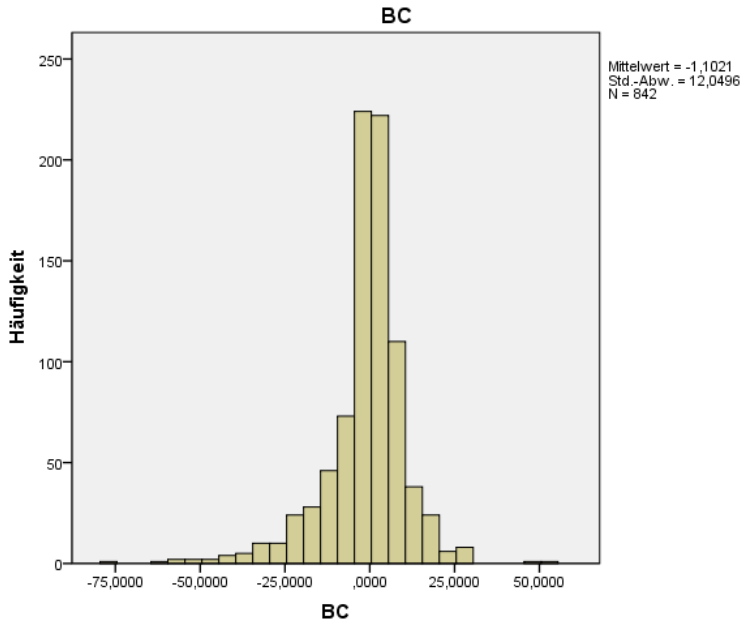

Figure 10: Frequency distribution of 1 minute MAAP measurements with absolute filter.

Figure 11 shows the timeseries of hourly average black carbon concentrations measured by the MAAP as retrieved from the database for the year 2009.

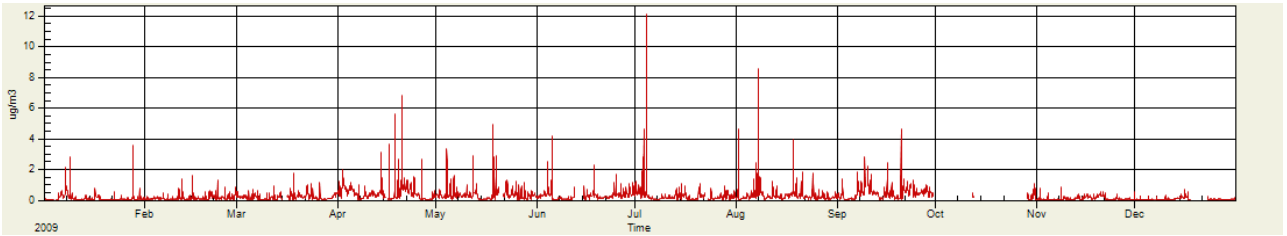

Figure 11: Maap data (1hour) retrieved from EBAS 2009.

TEOM:

The TEOM FMDS s/n 140AB265930703 at Puy de Dome is not operated in the context of EUSAAR. TEOM indicated flow is 2.99 l/min, measured flow is 3.088 l/min. The flow was adjusted to 2.986 l/min.

With an absolute filter attached this instrument indicated an aerosol mass concentration of 5 µg/m³. A parallel measurement with the CPC showed a number concentration of 0.3 cm^{-3}. These readings suggested an internal leak in the TEOM. The leak was found in the gasket of the filter housing by staff from the station.

Conclusion

The new laboratory at Puy de Dome offers all facilities needed at a EUSAAR site. Possible local pollution needs to be monitored closely. Some minor problems with the measurements have been identified during the audit, most of them have been solved immediately. This makes us confident that this site has provided reliable data and will provide them in the future. We wish to thank staff from the site for their hospitality.