Site audit report Cape Point, South Africa

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This site audit was done in the frame of the **GAW** program from May 3-4, 2006.

General

We were pleased to find the station in very good condition. This station has a long record of successful trace gas measurements in the GAW network. Basic aerosol measurements have been added in November 2005 (3 wavelength absorption coefficients, PSAP and 3 wavelength scattering and backscattering coefficient, TSI nephelometer model 356300). Setup of these instruments supplied by NOAA/ESRL (formerly NOAA/CMDL) has been performed with support from NOAA scientists. Ongoing measurements are continuously monitored by NOAA. All data are continuously updated on the webpage of NOAA. Available aerosol data have, however, not yet been submitted to the world data centre. The South African Weather Service has made plans to order a sun-tracker to add aerosol optical depth measurements in the near future. Mass concentration measurements are currently not available at CPT.

Personal

Operators of Cape Point station are well educated and highly motivated. Two CPT staff members have previously attended the aerosol course provided by GAWTEC (Schneefernerhaus). However, participation in future training programs like GAWTEC is essential to maintain the currently high standard.

Documentation and manuals

Documentation of all routine and extra maintenance of the system is completely available at the station. Detailed checklists with sufficient space for remarks have been filed in the past. In addition to these checklists all activities are stored in an online log.

A detailed operation manual for the whole system has been supplied by NOAA. During our audit original manufacturers manuals for the PSAP and Nephelometer were not available at the site. We provided a pdf copy of the TSI Nephelometer manual during our audit. An original manual for the PSAP should be provided to the station as soon as possible.

Data handling

Currently, the aerosol data from CPT is regularly and automatically downloaded to a server at CMDL NOAA. All measurement and diagnostic data are available at http://www.cmdl.noaa.gov/aero/net/cpt/data.html. Data is evaluated and flagged online by operators from CPT or Stellenbosch. Due to the limited bandwidth of the internet connection at CPT detailed data analysis at the site is, however, not feasible. Such analysis is therefore performed at the office located in Capetown. Immediate access to data to highly time resolved data (e.g. 1 minute averages) by station operators is, on the other hand, necessary to allow identification and tracking of possible malfunctions of the system and to provide hands on experience with the data.

We would therefore appreciate it if real time raw data could be accessible at the site either by directly storing a copy of the data on a computer at CPT (which would give additional redundancy for data security) or to mirror NOAA data and software on a near real time basis on a computer at CPT or Stellenbosch. We hope that the valuable aerosol data from CPT will be submitted to the data centre soon.

Aerosol inlet

The station uses a NOAA type turbulent aerosol inlet attached to the measurement tower. Samples are taken from 25 meters above the ground and are transported to the heated aerosol distribution by 20 cm ID PVC tubing at a flow rate of approximately 900 l/m. (Fig.1)

Calculations for aerosol particle penetration through this inlet have been provided by NOAA/CMDL (Fig.2).

Two Berner type impactors with cutoff-diameters of 1 µm and 10 µm are located in the measurement rack. The aerosol path is automatically switched every six minutes to provide alternating measurements for both size fractions.

Fig. 1: Main aerosol inlet attached to the tower (left) and heated aerosol inlet (right)

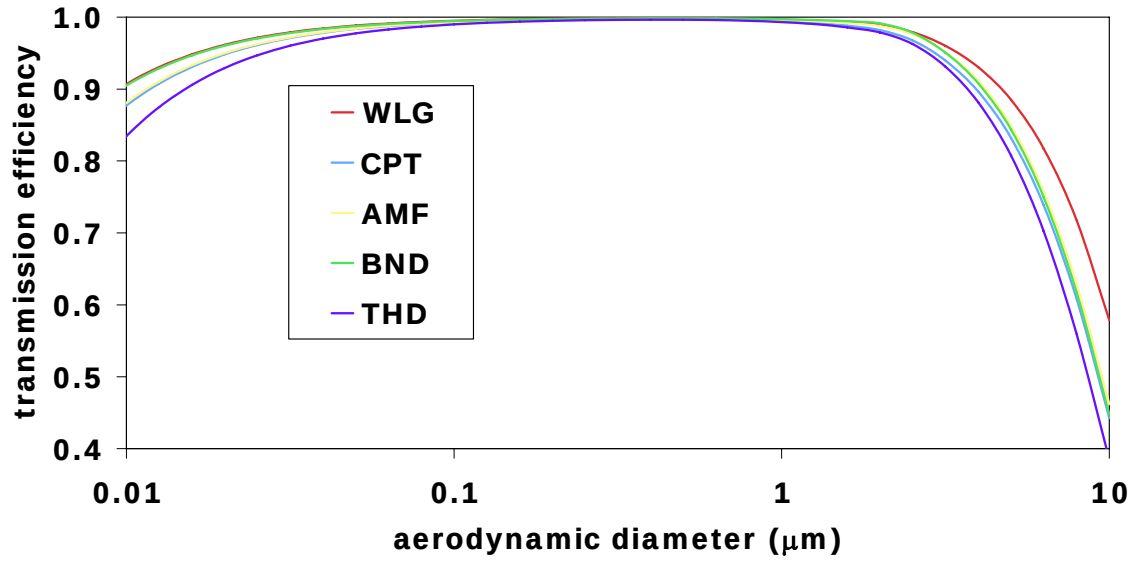

Fig. 2: Transmission efficiency CPT inlet

A main blower had failed shortly prior to our audit. With help from NOAA a bypass solution could be set up providing sufficient air flow with a single blower. The broken blower needs to be replaced soon in order to a) increase the lifetime of the existing blower and b) to allow continuous measurements in case of another fan failure.

While this type of inlet is suitable for measurements related to accumulation mode aerosol it needs to be mentioned that due to the material of the stack and due to the turbulent air flow this inlet should not be used for number size distribution measurements of particles smaller than 20 nm in diameter. If such measurements will be added in the future we recommend an additional stainless steel inlet according to GAW specifications.

Instrumentation

Absorption Coefficients

A three wavelength PSAP S/N 93 is available at the site. A problem with the O-rings sealing the filter holder occurred during our audit. New O-rings supplied by NOAA did not properly seal the filter holder. Station operators of CPT managed to buy suitable O-rings within 24 hours after occurrence of this problem.

The sample flow of the instrument is modified frequently to provide sufficient lifetime of the filters during unattended operation of the station. We have therefore calibrated the aerosol flow indicated on the display of the data acquisition computer against the primary flow standard from WCCAP. Results of this calibration are shown in Fig.3.

Computer indicated flow was in good agreement with the flow rate measured by the Gilibrator. Currently flow calibrations are not included in the routine operation of the instrument. Furthermore the primary flow standard available at CPT (Varian Intelligent Digital flowmeter USO04L26695) is not suitable for flow calibrations of the aerosol system because of its high pressure drop (Flow reading on computer dropped from 1.8 SL/m to 1.59 SL/m with Varian flowmeter attached).

Because electronic flow meters may change with time we recommend routine check of the flow sensors on a monthly basis. For this purpose a low pressure drop primary flow standard (e.g. Gilibrator) needs to be available at the site

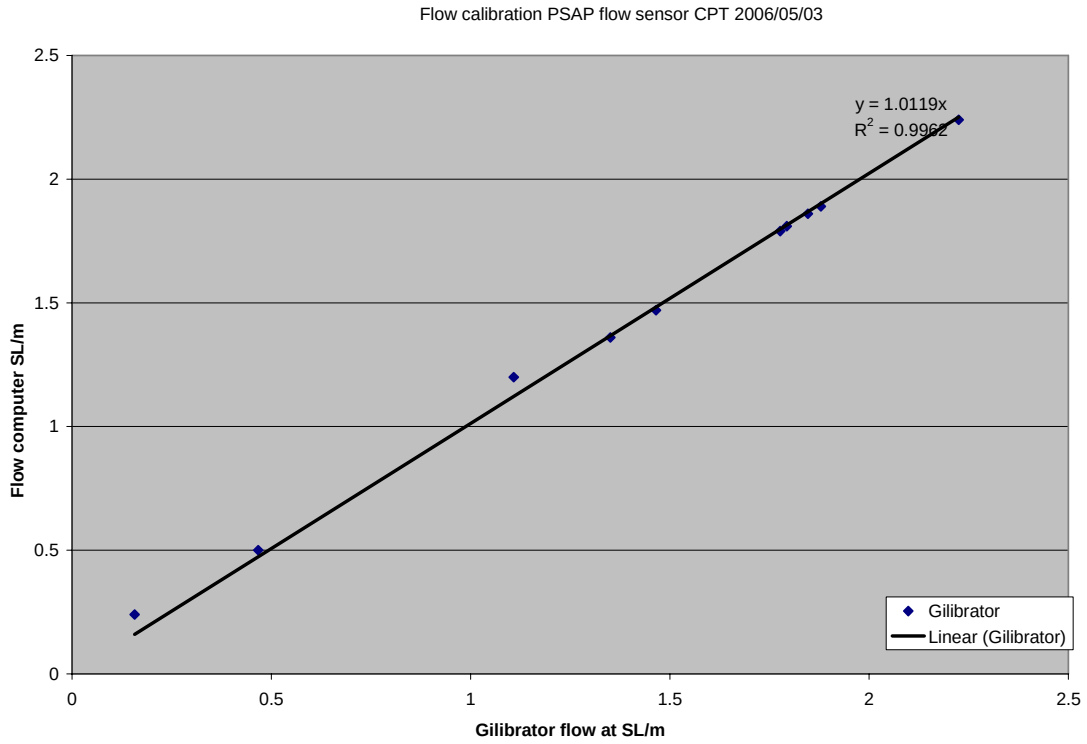

Fig. 3: Flow calibration PSAP flow sensor (computer display) versus Gilibrator.

We used a high efficiency filter to check instrument zero. Average values of -0.138+-0.057, -0.107 +- 0.07 and -0.053+-0.075 1/Mm where found for blue, green and red absorption coefficients. Time series of this zero measurement is shown in Fig. 4.

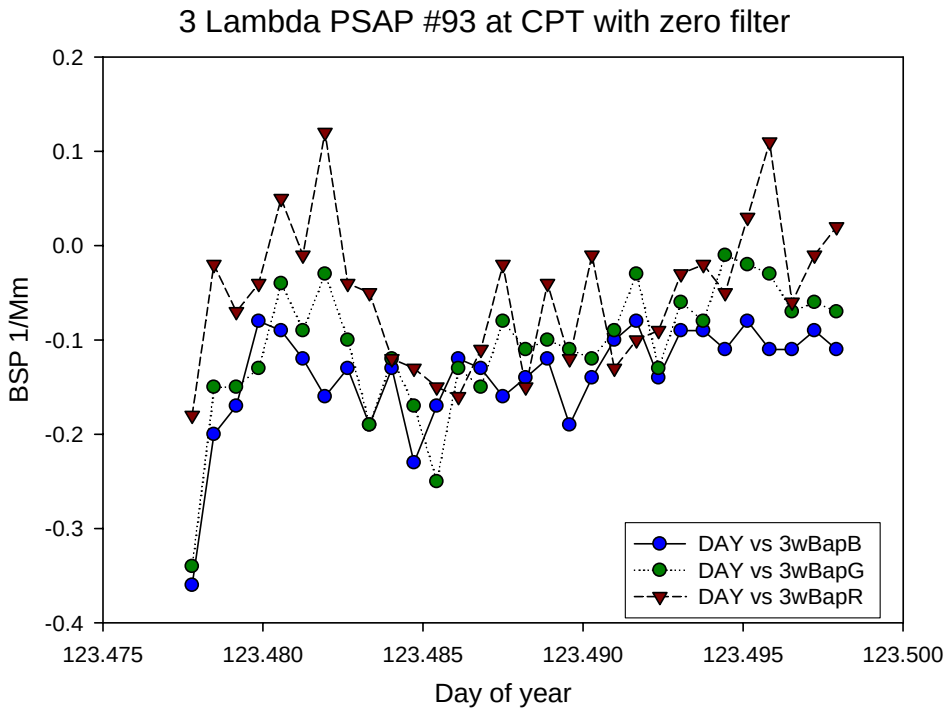

Fig.4: Time series of PSAP measurements with absolute filter.

The PSAP at Cape Point is in good working condition.

Scattering coefficients

A TSI Nephelometer S/N: 70520400 (May 2005) is used to measure 3 wavelength scatter and backscatter coefficients at CPT. A routine span check with filtered air and CO_2 is performed on a weekly basis. The instrument is operated at a flow rate of 32 l/min. Measurements with the absolute filter are shown in Fig.5. Mean values and standard deviations are summarized in table 1.

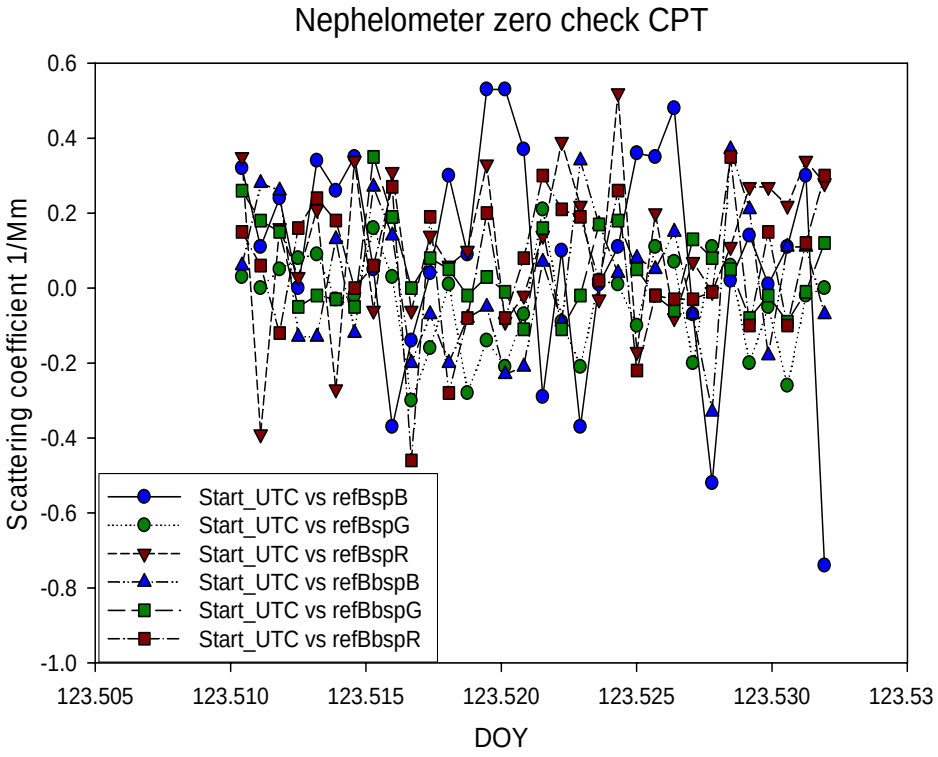

Fig. 5: Time series Nephelometer data with absolute filter.

	refBspB	refBspG	refBspR	refBbspB	refBbspG	refBbspR
Mean	0.09438	-0.0406	0.12125	0.02125	0.04781	0.06125
Std.Dev.	0.30166	0.13266	0.20393	0.18231	0.11327	0.18458

Tab. 1: Means and standard deviation of Nephelometer zero measurements

We noticed that the first Nephelometer lamp installed November 2005 was still in use. Because station operators of CPT had never exchanged a lamp previously we decided to exchange the lamp during the audit. A span check was performed prior and after lamp change.

The Nephelometer at CPT is in good working condition

Additional instrumentation

The scientific advisory group has defined a set of core parameters to be measured at global GAW stations in WMO/GAW AEROSOL MEASUREMENT PROCEDURES GUIDELINES AND RECOMMENDATIONS:

Multiwavelength optical depth
Mass in two size fractions
Major chemical components in two size fractions
Light absorption coefficient
Light scattering coefficient at various wavelengths

Currently measurements of aerosol optical depth and mass concentrations are not available. The acquisition of a suntracker is currently ongoing at CPT. A sun photometer will be supplied by the World Radiation Centre PMOD, Davos, Switzerland. We are therefore confident that measurements of aerosol optical depth will be available at Cape Point soon.

We recommend addition of a TEOM attached to the main sampling line after the switched impactors to complete the recommended set of physical aerosol parameters. It would be useful to include data acquisition for the TEOM into the existing data acquisition program to get synchronized information about the current cutoff diameter.

Conclusion

We are very pleased with the results from this audit. We wish to thank staff of CPT for there help and great hospitality. We are confident that aerosol measurements at Cape Point will provide valuable data for GAW.