Audit Report – Global GAW Station Cape Grimm, Australia

Period: March 26-27, 2018

Auditor: Prof. Dr. Alfred Wiedensohler, WCCAP, Leipzig

Station: Gape Grim

Station personnel: Nigel Somerville, Sam Cleland, Melita Keywood

I would like to thank the staff of the Cape Grim GAW station (Nigel Somerville and Sam Cleland) for this fruitful audit. Furthermore, I would like thank Dr. Melita Keywood for her engagement, organizing the audit.

General station information:

Country:	Australia
GAW ID	CGO
WIGOS Station identifier:	0-20008-0-CGO
Coordinates:	40.682220459°S, 144.6883392334°E, 94m
Climate:	Warm temperate climate, fully humid, warm summer
Annual dew point temperature:	Up to approximately 18°C, see Figure 1

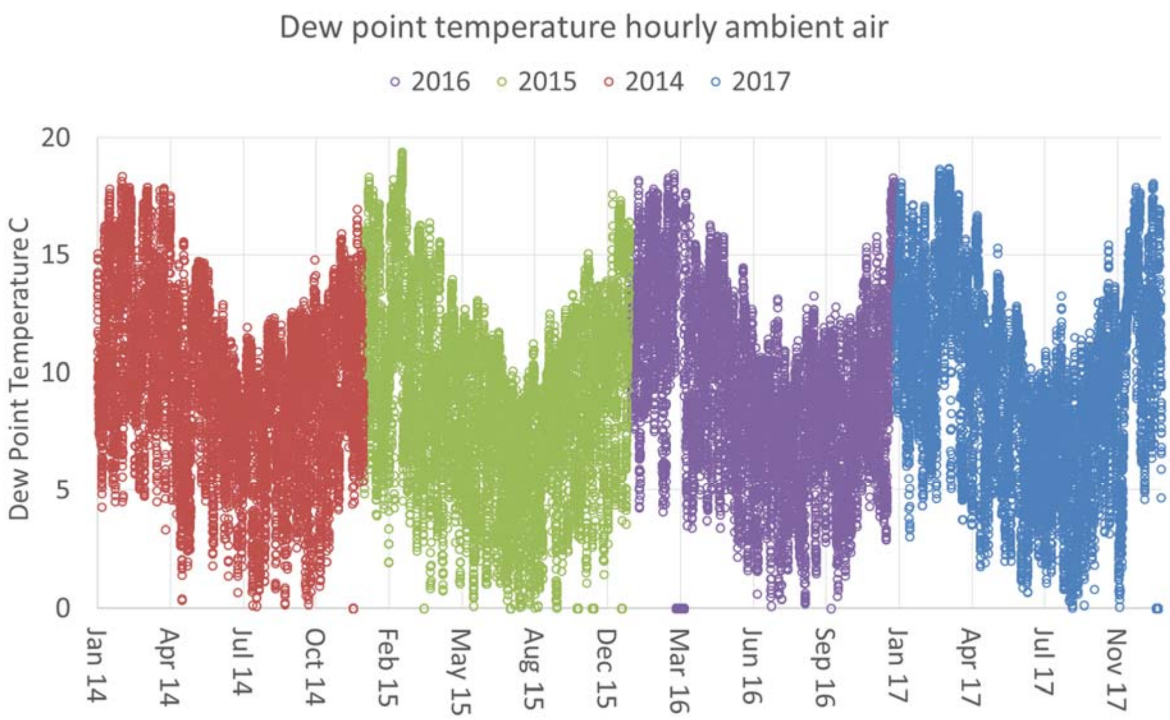

Figure 1: Seasonal variation of dew point temperature at the Cape Grim Global GAW station for the period Jan 2014 to Nov 2017.

Figure 1 illustrates that the maximum possible dew point temperature is about 18°C during summertime. This mean that it is necessary to dry the aerosol in the station to obtain a relative humidity (RH) below 40% in the instruments.

Comments:

- The temperature in the laboratory seems to be always around 25°C, helping to lower the relative humidity.

Recommendation:

- Drying of the individual aerosol flows for the individual instruments is needed.

Inlet and indoor splitter:

In Figure 2, the main inlets is show, while Figure 3 shows the splitter inside of the station.

Figure 2: main aerosol inlet of Cape Grim.

Figure 3: Aerosol splitter in the station.

Comments:

A whole stainless steel air inlet witch an ID of 150 mm samples aerosol from a height of 10 m above the roof of the laboratory building.

Recommendations:

- No further recommendations

Particle light scattering coefficient:

Instrument:	Integrating Nephelometer: Ecotech model Aurora 4000
Serial Number:	17-0853
Instrument:	Integrating Nephelometer: Ecotech model 9003
Serial Number:	07-0268
Zero check:	once per day
Span check:	CO_2 every day
RH regulation:	Heating system after the splitter, regulated heating in the integrating nephelometer
Last instruments intercomparison:	never
Last manufacturer check:	9003 had never been checked, the 4000 is new from 2017
Frequency of cleaning the instrument:	annually
Data submitted to WDCA:	done, but uncorrected

Comments:

- The integrating nephelometer run behind a PM1 cyclone (16.7 l/min) to prevent contamination with sea salt.
- The heating system in the pipe after the splitter has no effect, because the temperature at the instrument inlet if at room temperature.
- Data are not corrected for illumination nor for truncation. The 9003 has to be especially corrected for the illumination function, taken from literature (see Müller et al.)
- The instruments are kept at 5 l/min each and to maintain the cyclone flow, an additionally make-up flow is kept.

Figure 4: Set-up of the two Ecotech integrating nephelometers.

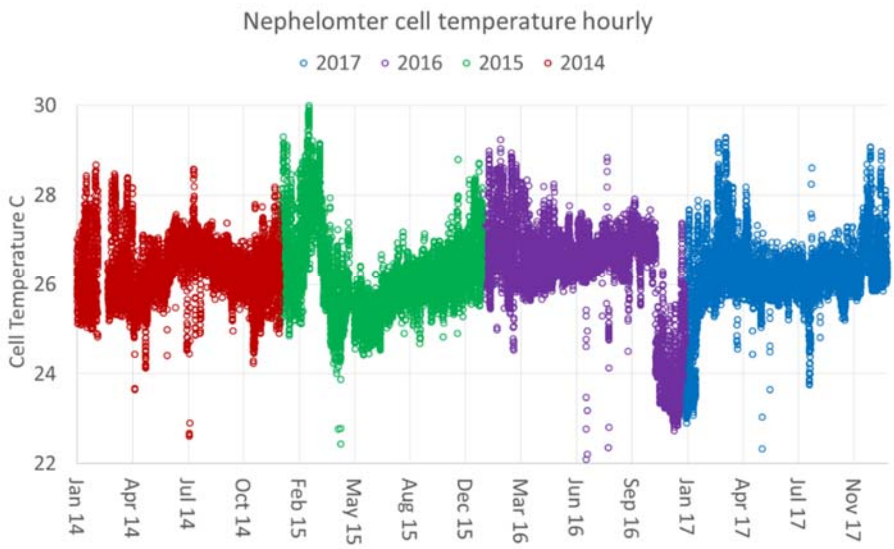

Figure 5: Seasonal variation of temperature inside of the integrating nephelometer for the period Jan 2014 to Nov 2017.

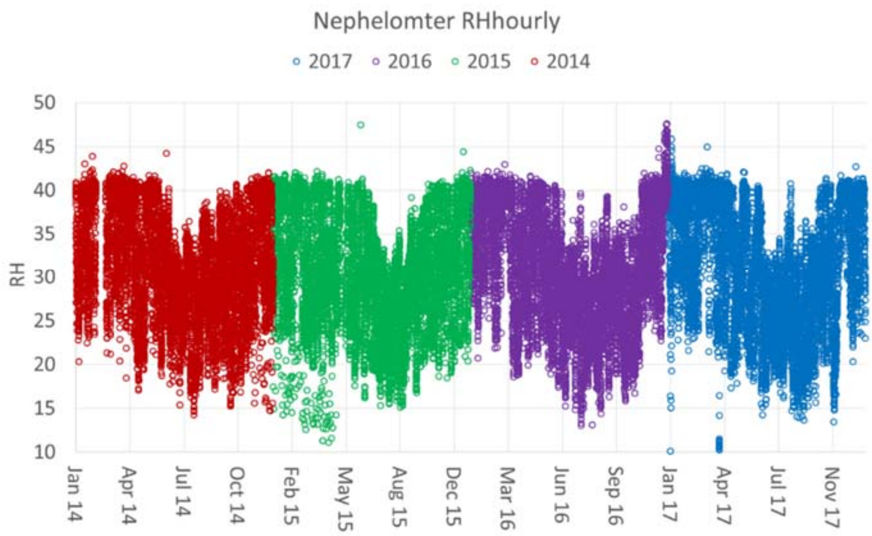

Figure 6: Seasonal variation of relative humidity inside of the integrating nephelometer for the period Jan 2014 to Nov 2017.

Figure 5 illustrate the regulated heating of the integrating nephelometer to maintain a RH below 40% inside of the cell. The temperature never exceeded 30°C, which is good. The RH inside of the integrating nephelometer is shown in Figure 6. Most of the time the RH can be kept below 42%. This is within the uncertainty range and therefore good. In Figure 7 and 8, the results of the Zero tests of both integrating nephelometers are shown, meeting the requirements.

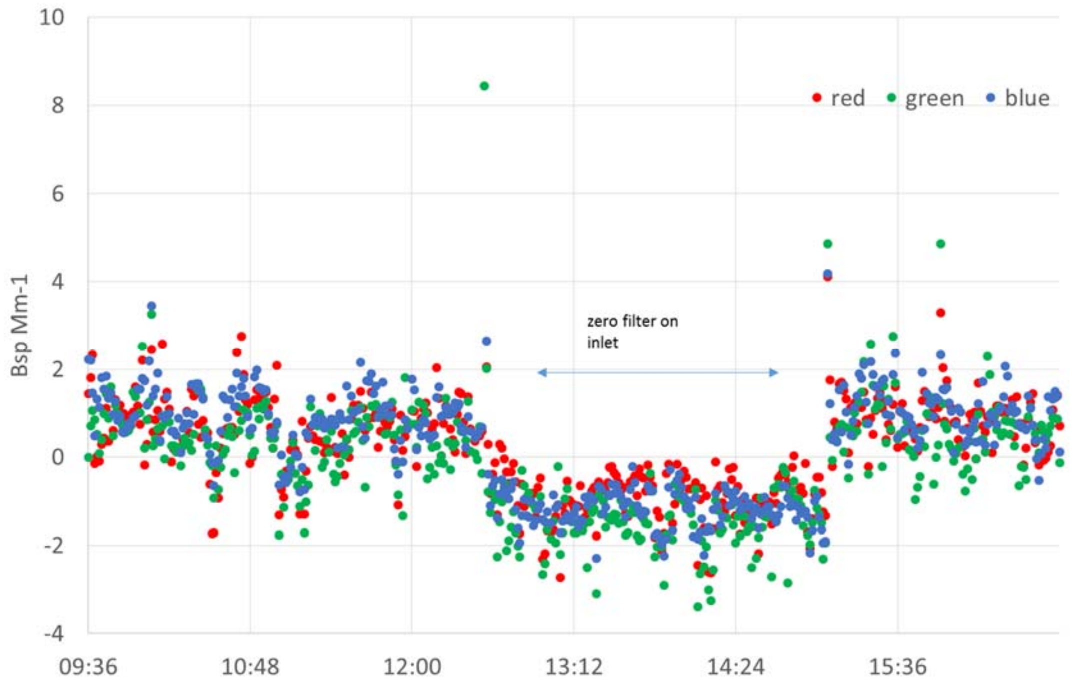

Figure 7: Zero check of the Ecotech 9003 integration nephelometer. During that day, the concentration seems to very low. During period with a filter at the inlet of the instruments, the values are around 0 to $-2*10^{-6}$ m^{-1}, which is reasonable.

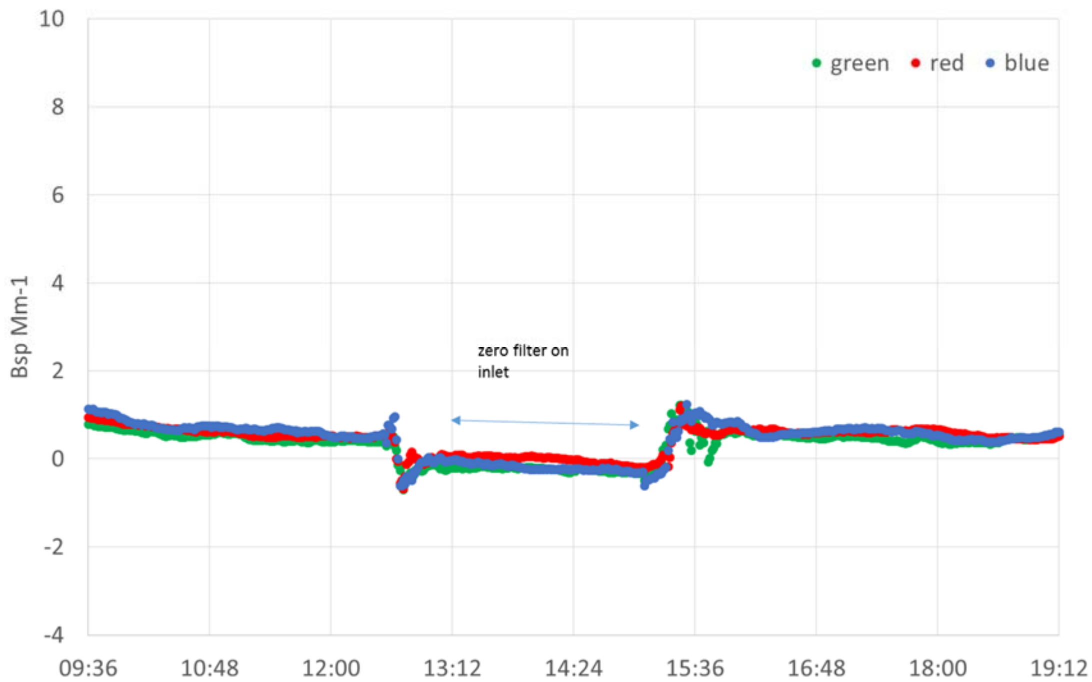

Figure87: Zero check of the Ecotech Aurora 4000 integration nephelometer. During that day, the concentration seems to very low. During period with a filter at the inlet of the instruments, the values are around $0*10^{-6}$ m^{-1}, which is very good..

Recommendations:

- The heating system in the pipe can be removed, since it has no effect
- The cyclone can be placed directly after the splitter.

- Each integrating nephelometer should be regulated with a mass flow controller to 8.3 l/min
- After looking at the existing span checks, the fluctuation was very small, meaning that the span check calibration can be done monthly, also to save time and CO_2 gas.
- Data has to be corrected properly for truncation and illumination, possible also retroactively.
- Please check if the metadata of the existing data at the WDCA are correct in terms of size range (PM1 dry) and missing correction

Particle light absorption coefficient

Instrument:	Absorption Photometer: Thermo MAAP
Serial Number:	Z-Nr 42545/15
Instrument:	Absorption Photometer: Brechtel TAP
Serial Number:	TAP008
Zero check:	annually
RH regulation:	Heating system in the pipe after the splitter.
Last instruments intercomparison:	never
Last manufacturer check:	never

Comments:

- The absorption photometers run behind a PM1 cyclone (16.7 l/min) to prevent contamination with sea salt.
- The heating system in the pipe after the splitter has no effect, because the temperature at the instrument inlet if at room temperature.
- A quick look at the scatterplot between MAAP and TAP for the red wavelength shows that the TAP is factor 2 lower, at least for values greater than 2 Mm^{-1}.

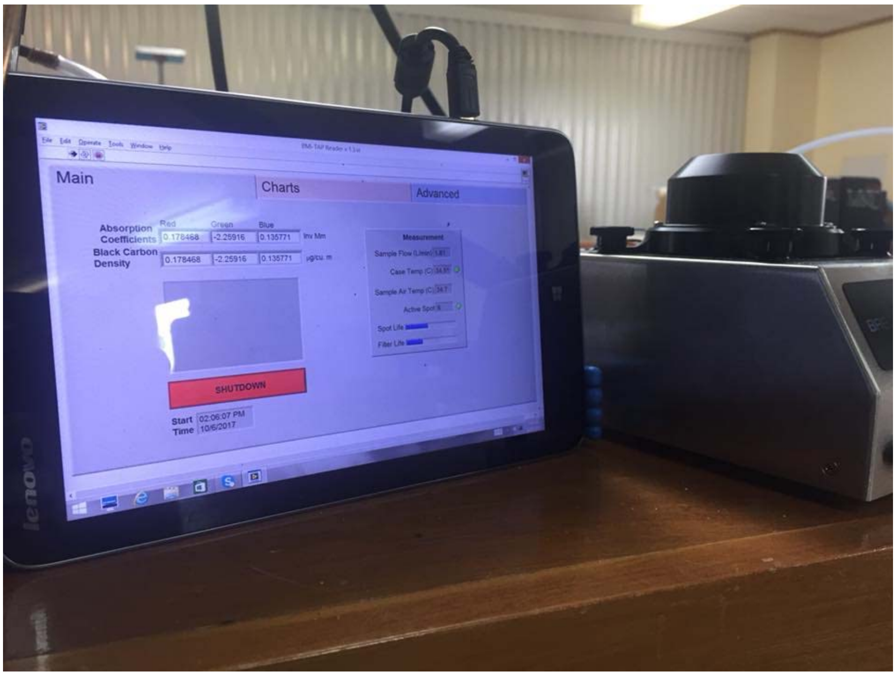

Figure 7: TAP for particle light absorption measurements

Figure 8: Multi-Angle Absorption Photometer

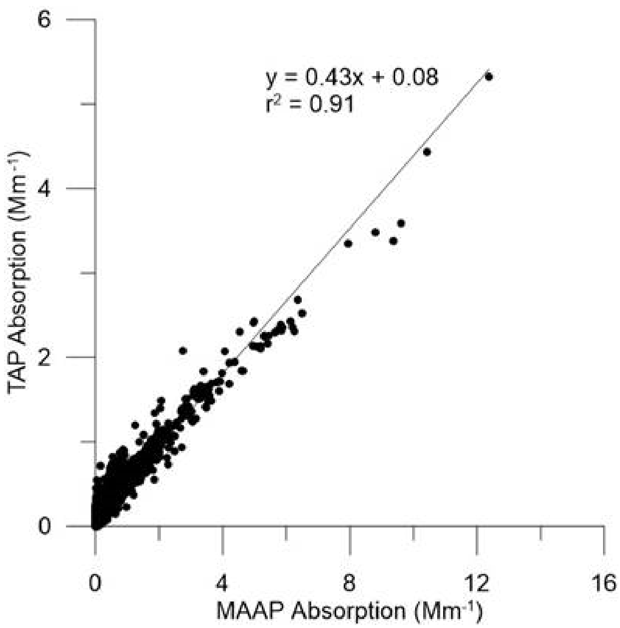

Figure 9: Scatterplot the particle light absorption coefficient in the red wavelength between the MAAP and the TAP

Recommendation:

- A Nafion dryer (maybe two in parallel to handle the high flow rate) should be used in the sampling line to reduce the RH for the filter-based absorption measurements
- RH/T sensors should be placed at the inlet of the MAAP and the TAP.
- The TAP should be sent to a calibration workshop to check the performance.

Particle number concentration

Instrument:	CPC model: TSI 3010
Serial Number:	70415197
Instrument:	CPC model: TSI 3772
Serial Number:	130801
Instrument:	CPC model: TSI 3776
Serial Number:	6170402
Instrument:	CPC models: TSI 3776
Serial Number:	71014249
Zero check:	yearly
RH regulation:	no dryer
Last instruments intercomparison:	never
Last manufacturer check:	never

Comments:

- We did a zero check by putting small HEPA filters between the sampling line and inlet of the CPCs. After 10 min, all instruments went down a perfect zero count.
- Data for 2013-2017 are in the WDC Aerosols. Number concentration data from 2006-2011 were submitted to the WDCA at ISPRA have not been transferred to the NILU hosted WDCA

Figure 10: Times series of the 4 CPC for March 25, 2018.

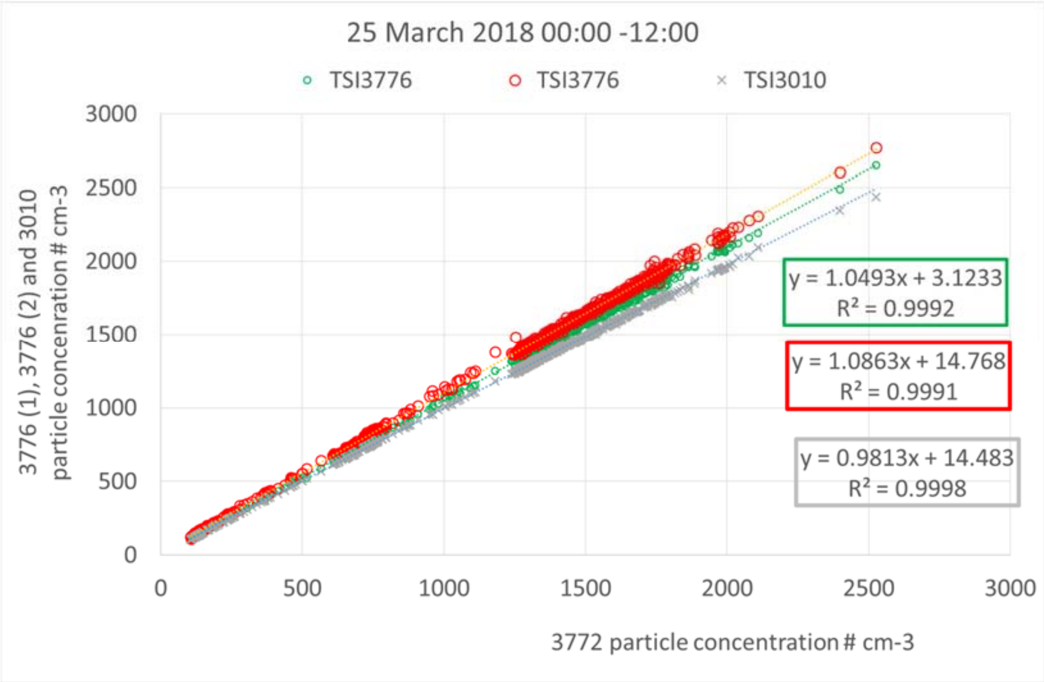

Figure 11: Scatterplot the two TSI 3776 and the TSI 3010 against the TSI 3772 as an internal reference. Data are taken from the nighttime measurement of March 25, 2018. The difference are still with the target uncertainties.

Recommendation:

- The zero check should be done monthly
- At least one CPC, e.g. the TSI 3772, should be sent yearly for a calibration, which can then be used a reference instrument.
- Recent data have to be submitted to the WDCA in NASA-AIMS format.

Cloud condensation nuclei number concentration

Instrument:	CNNC model: DMT CNN-100
Serial Number:	CCN-1: 0408-0058
Instrument:	CNNC model: DMT CNN-100
Serial Number:	CCN-2: 1705-50
Zero check:	annually
Calibration:	annually (recently)
Last instruments intercomparison:	never (only among each other)
Last manufacturer check:	never

Comments:

- Data are submitted to WDCA from 2012 to 2016.

Figure 12: Set-up of the two DMT CCN counters.

Recommendation:

- At least one CCNC should be sent yearly for a calibration, which can then be used a reference instrument, also to harmonize the calibration procedure, which was developed within ACTRIS