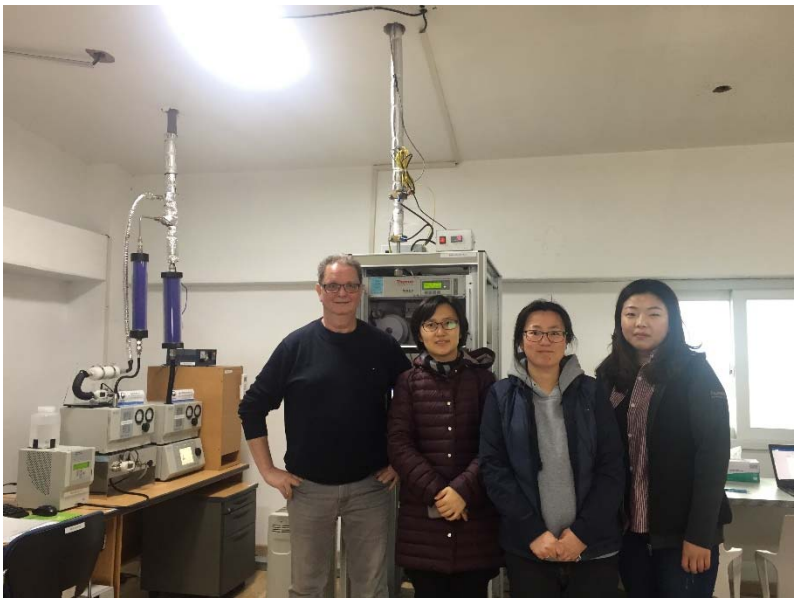
Audit Report – GAW Station Jeju Gosan, South Korea

Period:	March 08, 2018
Auditor:	Prof. Dr. Alfred Wiedensohler, WCCAP, Leipzig
Station:	Jeju Gosan, South Korea
Station personnel:	Ji-young Jeong, Miyoung Ko, Jeongeun Kim (KMA)



I would like to thank Dr. Jeongeun Kim for her engagement, organizing the audit and also for fruitful discussions. Furthermore, I would also like to thank the station personnel (Ji-young Jeong and Miyoung Ko) for their engagement, keeping the instruments running.

General station information:

Country:	South Korea
GAW ID	JGS
WIGOS Station identifier:	0-20008-0-JGS
Coordinates:	33.1800°N, 126.1200°E, 52m
Climate:	Warm temperate climate, fully humid, hot summer
Annual dew point temperature:	The annual dew point temperature reaches values up to 28°C, see also figure 1.

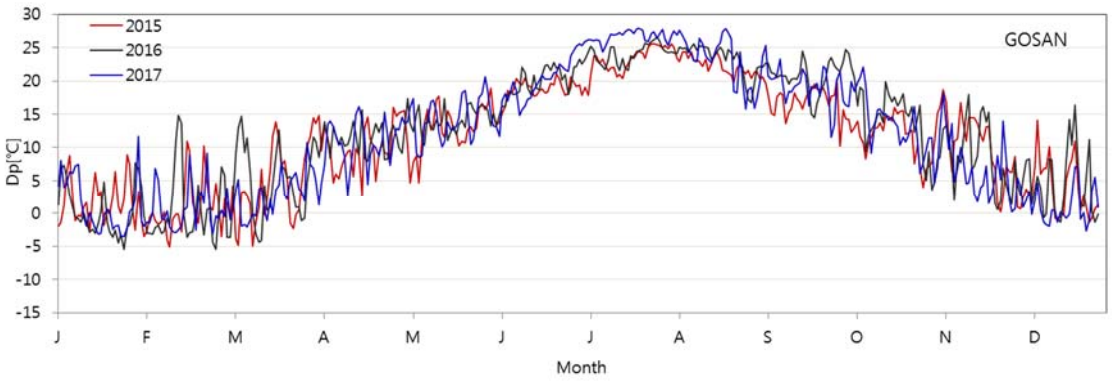


Figure 1: Seasonal variation of dew point temperature at the Jeju Gosan station for the years 2015-2017.

Figure 1 illustrates the critical months in terms of aerosol in-situ measurements, when the dew point temperature is above 20°C. This is always the period from June to September. During this period, it is difficult to condition the aerosol to a relative humidity below 40%.

Recommendation:

- I strongly recommend keeping the room temperature in summertime above the dew point temperature to a) avoid condensation and the sampling pipes, and b) to minimize the influence of high relative humidity on the aerosol measurements.

Inlets:

The inlets numbers 1 and 2 are shown In Figure 2.

1. Low flow PM10 inlet (16.7 l/min) for the measurements of the particle number size distribution and number concentration. The tube diameter of ½" is sufficient to maintain a laminar flow.
2. Low flow PM10 inlet (16.7 l/min) for the measurement of particle mass concentration. The tube diameter of 3/8" is sufficient to maintain a laminar flow.

Comments:

- No further comments

Figure 2: Jeju Gosan GAW Observatory. Numbers 1 and 2 indicate the two PM10 inlets for the GAW aerosol in-situ measurements.

Particle number concentration

Instrument:	CPC: TSI 3772
Serial Number:	71014239
Diluter	TSI 3302A
Serial Number	71018226
Zero check:	annually
RH regulation:	Diffusion dryer upstream of the instrument
Last instruments intercomparison:	never
Last CPC calibration:	never
Last manufacturer check:	Sep. 2017
Aerosol flow check:	monthly
Cleaning of CPC:	bi-monthly

Comments:

- For drying, an aerosol diffusion dryer is used.
- The heating in front of the dryer might be only useful to avoid condensation in summertime. However, it does not reduce the RH for the measurements.
- The particle number concentration is diluted by a diluter by factor 20
- Data should be submitted to the WDCA

Recommendation:

- I recommend replacing the diffusion dryer (which has high diffusional losses for ultrafine particles) by a SS2100 Nafion dryer, operated under vacuum for the counter flow (or alternatively with dry air). The pump should be able to create a pressure of 200 mbar or lower, with a volume flow rate of 2 l/min at the entrance of the pressure reducing needle valve. The inner Nafion tube needs to be replaced yearly.
- I recommend sending the CPC annually to the world calibration center for calibration and cleaning
- I recommend reducing the dilution ratio from 20 to a factor 2-3. A TSI CPC 3772 can measure up to 20,000 1/cm^3 after life-time-correction (serial port).

Figure 3: Condensation particle Counter (CPC) including a diluter, reducing the number concentration by factor of 20.

Figure 4: Aerosol diffusion dryer for the particle number and size distribution measurements. The left one is for the CPC and the right one for the APSS.

Particle number size distribution

Instrument:	APSS: Aerodynamic Particle Size Spectrometer TSI model 3321
Serial Number:	71650010
Diluter	TSI 3302A
Serial Number	70835206
Zero check:	bi-annually, last in Oct 2017
RH regulation:	Diffusion dryer upstream of the instrument
Last instruments intercomparison:	never
Last manufacturer check:	Nov. 2017
Last size calibration:	never by staff
Aerosol flow check:	monthly
Total flow check:	monthly
Change of HEPA filter:	bi-annually

Comments:

- For drying, an aerosol diffusion dryer is used.
- The heating in front of the dryer might be only useful to avoid condensation in summertime. It does not reduce the RH for the measurements.
- The particle number concentration is diluted by a diluter by factor 20
- Data should be submitted to the WDCA

Recommendation:

- I recommend removing the diluter to improve the counting statistics.
- I recommend that PSL sizing checks (if possible with three sizes) should be done bi-annually. The size accuracy should be within 10%. (Pfeifer et al; 2016).
- I recommend placing a RH/T sensor in front of the instrument.

-

Figure 5: Set up for the particle number size distribution measurements with an Aerodynamic particle Size Spectrometer (APSS) and a diluter, reducing the number concentration by a factor of 20.

References:

Pfeifer, S., T. Müller, K. Weinhold, N. Zikova, S. Santos, A. Marinoni, O. F. Bischof, C. Kykal, L. Ries, F. Meinhardt, P. Aalto, N. Mihalopoulos and A. Wiedensohler (2016). Intercomparison of 15 Aerodynamic Particle Size Spectrometers (APS 3321): Uncertainties in Particle Sizing and Number Size Distribution. AMT 9, 1545–1551.

Particle mass concentration

Instrument:	Mass monitor: Thermo FH62C14 (beta-attenuation)
Serial Number:	E-1721
Zero check:	Last March 5, 2018; monthly
RH regulation:	Heating upstream of the instrument
Last instruments intercomparison	
to reference:	not available yet
Aerosol flow check:	monthly

Comments:

- The heating is set to approximately 40°C. This will likely evaporate e.g. ammonium nitrate, leading to lower particle mass concentrations in wintertime.
- The effect of heating to reduce RH is however minimum, since the tube at the instrument inlet is almost at room temperature

Recommendation:

- I recommend performing a year-long intercomparison between the FH62C14 and the reference method (24h filter; gravimetric)
- I recommend replacing the heating by an aerosol diffusion dryer and ensure that no silica particles are produced.
- I recommend placing a RH/T sensor at the inlet of the instrument to obtain the real RH in the monitor.

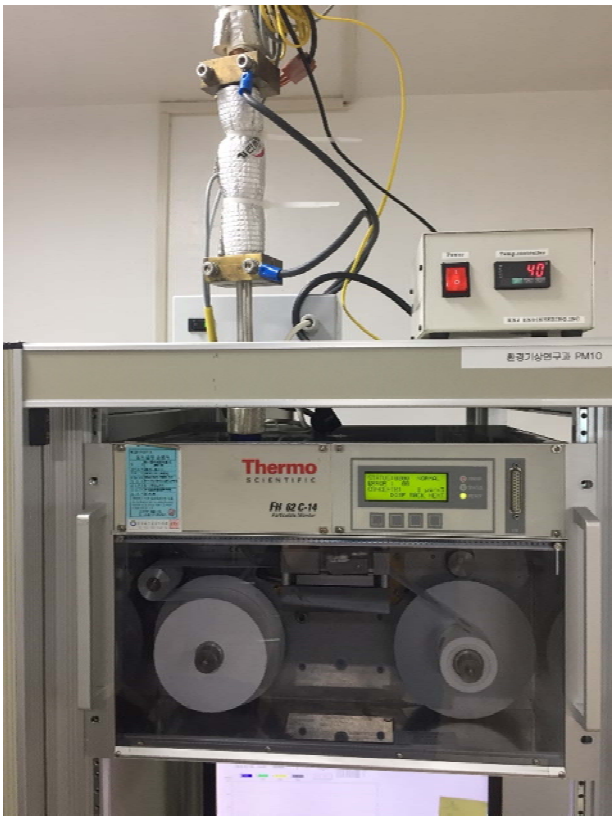


Figure 6: Beta-attenuation mass monitor with a heating unit above.