Site audit report Birkenes, Norway

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Summary:

Measurements of physical aerosol properties at the EUSAAR site Birkenes were audited by Thomas Tuch of the WWCAP on October 6th and 7th 2009. The site is located in southern Norway, to the south-east of the Scandinavian mountain chain at 56º 23' 19" N, 8º 15' 10 E, 172 m above sea level. Known local emission source areas are Norton industries in Lillesand (15 km SE), Kristiansand city (25 km S/SW). Both are known to have minor or even negligible influence on the air quality at the site. A Google earth view of the site is shown in figure 1.

Figure 1: Google earth view of old and new measurement site at Birkenes.

The site is operated by the Norwegian Institute for Air Research (NILU). A new measurement facility has been build in 2009 on a small hill about 100 m SE of the original station. This new facility is better exposed to wind from all directions than the original station. It is well designed to avoid pollution of the ambient air by station exhaust. Rooms are kept at a constant under pressure. Exhaust air from the station is released to the environment about 60 m away from the site. Figure 2 shows an exterior view of the new station and a view from the old to then new site.

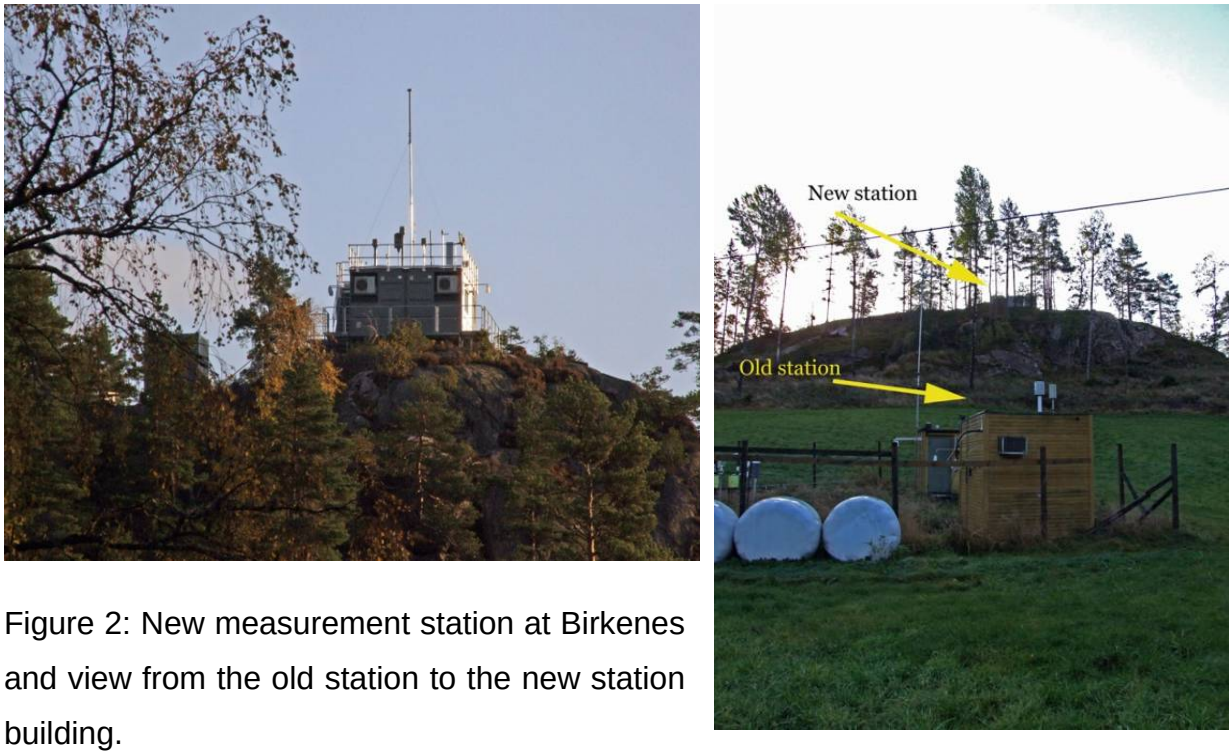

Figure 2: New measurement station at Birkenes and view from the old station to the new station building.

The new site is in operation since the end of summer 2009. Observed problems with some instruments at the site during the audit can be attributed to the short up time of the station. With its excellent infrastructure the new site at Birkenes will be very valuable for the EUSAAR network.

Documentation and data handling:

Manuals for all commercial instruments are available at the station. SOPs for most instruments are available. Electronic logs are filed in detail. These logs along with the online access to current measurement data allow good control of the station by the responsible scientist in Oslo. **Data submission to the EMEP data centre is on time**.

Documentation and data handling at Birkenes comply with EUSAAR standards.

Primary flow standard:

A Drycal S/N871 Station reference is available as primary flow standard at the site. This instrument is acceptable as primary flow standard if no instrument which is subject to influence of the pressure drop of the DryCal is used at a site. The flow standard has been verified against the WCCAP reference during this audit (Figure 3).

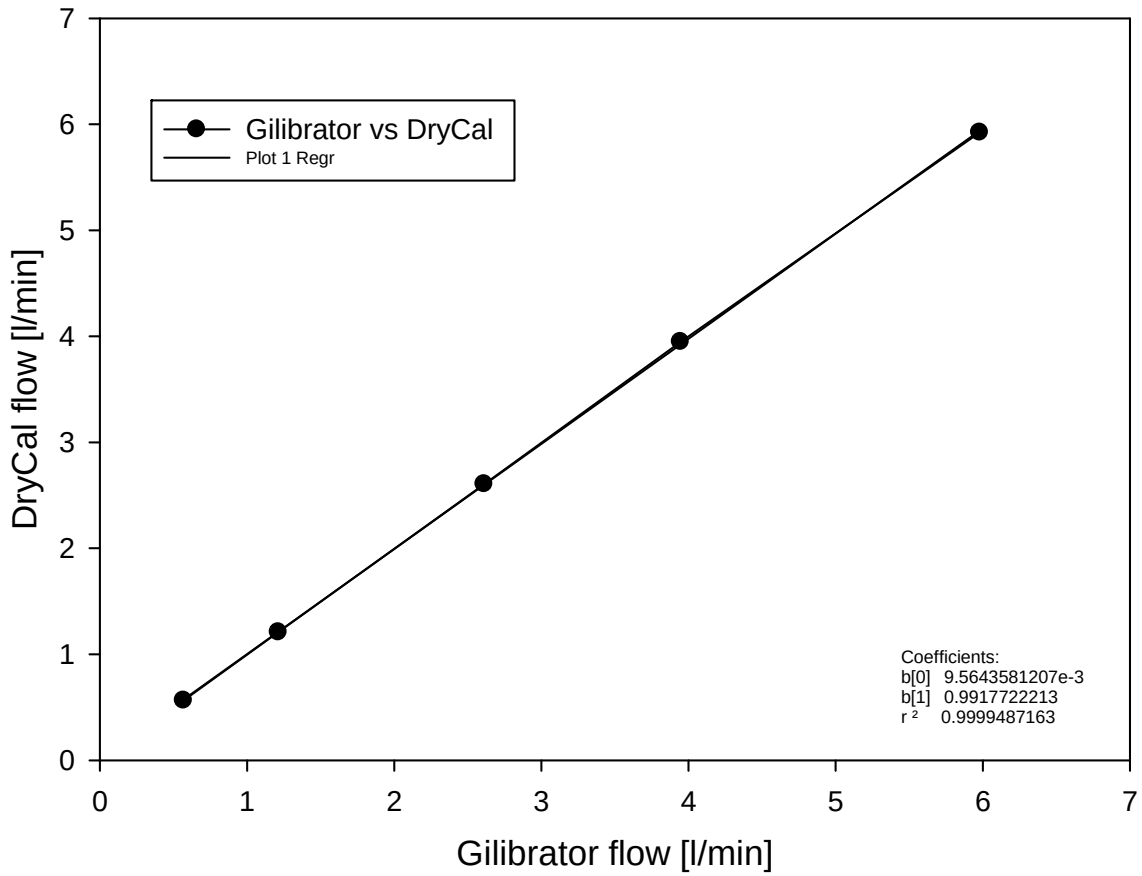

Figure 3: Comparison of flow standards at Birkenes with WCCAP standard.

The primary flow standards comply with EUSAAR requirements.

Aerosol inlets:

Two aerosol inlets are used at Birkenes. The left one in figure 4 is a whole air inlet for the Grimm OPC. The right one is a custom designed heated inlet by Digitel operated at a flow rate of 140 l/min. All other aerosol instruments sample from this inlet. All aerosol lines are made of stainless steel. A Nafion dryer is used for humidity conditioning for the DMPS. Samples for the PSAP and the Nephelometer are not humidity conditioned. Heating may only be suitable to adjust aerosol rH for these instruments if the ambient temperature does not exceed the temperature of the laboratory if ambient rH exceeds 50%.

Figure 4: Aerosol inlets at Birkenes. Inside view

Statistical analysis of hourly temperature and relative humidity data for Birkenes obtained from the EBAS database is shown in table 1.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
rH	68671	-25.30	28.40	6.4616	7.73425
temp	66409	7.50	103.10	78.1248	19.17704
Valid N (listwise)	66333				

Table 1: Hourly temperatures and relative humidity at Birkenes (1.1.2000-21.11.2007).

During this time period hourly average ambient humidity > 50% at temperatures exceeding 21^0 C occurred for 508 hours (<1%). The scatter plot of humidity versus temperature (figure 5) shows this area. These rare cases need to be flagged in the PSAP and Nephelometer dataset accordingly.

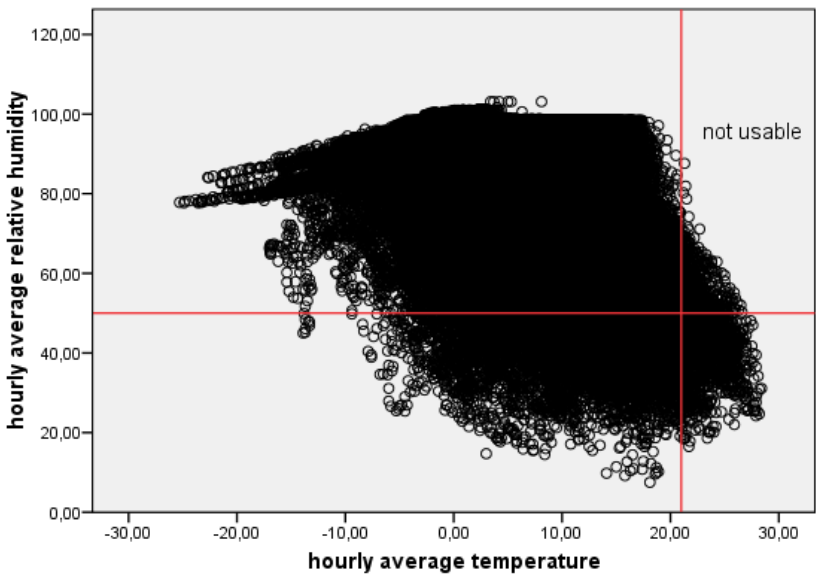

Figure 5: Scatter plot of hourly average temperature and relative humidity at Birkenes.

Aerosol inlets at Birkenes comply with EUSAAR requirements.

Number size distribution:

Number size distribution at Birkenes is measured using a single closed loop DMPS system with a Hauke medium type DMA and a TSI CPC 3010 S/N 2372. Custom made software is used for data acquisition. Apart from a missing aerosol flow sensor (the CPC is operated with a critical orifice) this instrument is build according to EUSAAR specifications. The DMPS system has participated in inter comparison workshops at the IFT. During these the instrument has worked properly. An example of the sizing accuracy of this instrument during the inter comparison workshop in June 2009 is shown in figure 6 (black line, A. Nowak and A. Wiedensohler: EUSAAR-S/DMPS Workshops, June 2009,First Results).

A first zero test with an absolute filter on the inlet showed no leaks. There was, however, a discrepancy between aerosol flows measured at the inlet of the CPC (0.9689 l/min) and at the inlet of the system (0 .94 l/min). This small discrepancy was due to a small leak introduced into the system during a check one day prior to the audit. According to the logbook the previously measured aerosol flow at the inlet of the system (0.9616 l/min) was in good agreement with the flow measured at the CPC. The sheath air flow was found to be 5.1 l/min accordingly. The small leak was fixed during the audit. Particle sizing was checked with 200 nm Latex (figure 7). Match of the peaks in figures 6 and 7 is perfect.

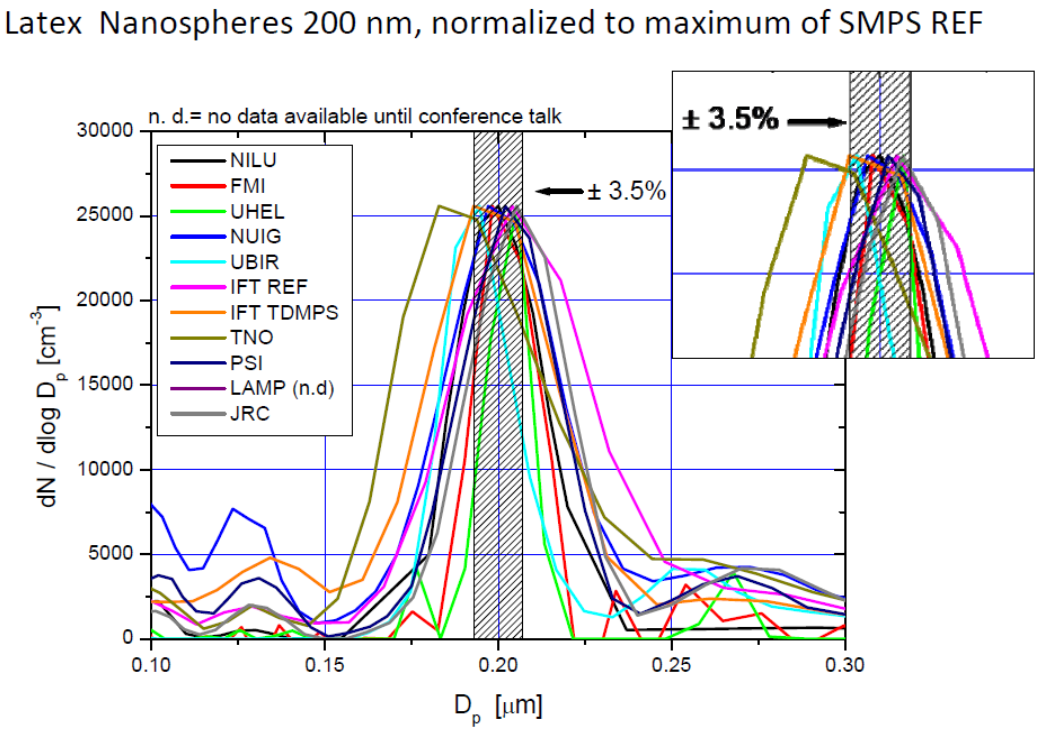

Figure 6: Raw number size distribution of 200 nm Latex measured during 2009 SMPS intercomparison workshop in Leipzig (black line, NILU).

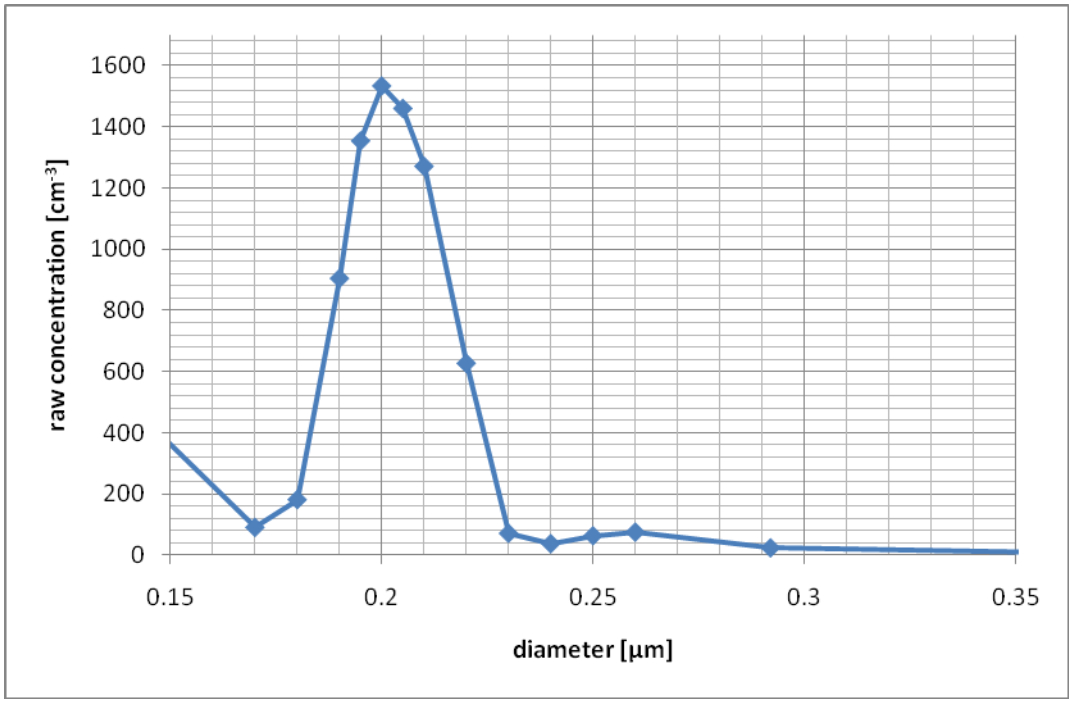

Figure 6: Raw number size distribution of 200 nm Latex, Birkenes DMPS.

The DMPS at Birkenes works according to EUSAAR specifications

Absorption Photometer:

A homemade Finish PSAP is available for measurement of the absorption coefficient at Birkenes. The signal of the instrument is rather noisy. This is most probably due the unshielded cables used in this instrument (figure 7).

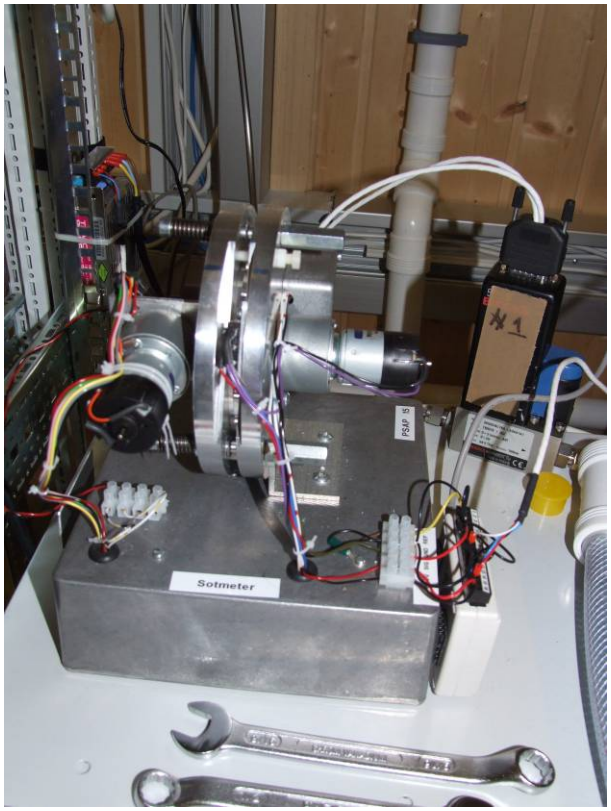

Figure 7: Homemade PSAP at Birkenes

PSAP data need to be prepared by the station personnel. Data for the overnight zero run are currently not yet available.

We suggest replacing the PSAP at Birkenes with a commercially available instrument such as a MAAP or an Aethalometer.

Nephelometer:

A three wavelength Nephelometer TSI 3563 S/N 70810508 is used to measure scattering coefficients at Birkenes at a flow rate of 20.09 l/min. Flow rate of this instrument is checked by a TSI flowmeter mounted at the outlet of the instrument. Measured flow agreed with flowmeter readings. The aerosol is not humidity conditioned. Data from this instrument need therefore to be flagged if the rH exceeds 50%.

The (almost new) instrument was defective prior to the audit. There is a problem with the red channel which gives erroneous readings. For example the red channel gives a higher signal for zero measurements than for span (CO_2) gas measurements (figure 8). Neither calibrations nor zero check could therefore be made during the audit.

Figure 7: Calibration screen of the Nephelometer at Birkenes.

We attempted to fix the problem with instructions given by TSI. We were, however, not successful. The instrument was send to the manufacturer for repair after this audit.

The Nephelometer at Birkenes needs to be repaired by the manufacturer.

OPC:

Particles in the size range from 0.25 µm to 32 µm are measured by a Grimm EMD 180 S/N 18A08016. This instrument has been modified to alternate between mass concentration measurements (PM2.5 and PM10) and measurements of the number size distribution in this size range. The instrument uses a heated whole air inlet at a sample flow rate of 1.2 l/min. The flow rate can unfortunately only be checked by disconnecting the instrument from the inlet. The flow rate was measured at 1.199 l/min. It was in good agreement with the design flow rate of 1.2 l/min. The construction of the inlet makes it impossible to run a zero check on this instrument (the instrument needs to be attached to the manufacturer supplied inlet for operation. A zero filter cannot be mounted on this inlet). We suggest modification of the inlet to allow for routine zero measurements. The quality of particle mass concentration measurements is currently evaluated by parallel filter measurements.

The OPC at Birkenes seems to be in good working condition.

Conclusion:

We did find a few problems at the site which need to be addressed in the near future. It needs to be reminded that the station is new and had only started measuring some weeks prior to the audit. All technical problems may, however, be solved without much effort.

We are confident that data quality from Birkenes will improve with the new station.

We wish to thank all persons involved in this audit for the hospitality and hope that our findings during the audit will help to improve measurements of physical aerosol properties at Birkenes.